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PHYSICAL PROPERTIES OF ASPHALTS.

EXPERIENCING the ordinary difficulty met with in attempting to dissolve asphalt in alcohol, and entertaining an opinion that something more could be done, the writer assumed the comparative failure to be due to the lack of penetrating property of the alcohol in relation to the asphalt. If the asphalt was finely powdered, thereby increasing the area of its surface exposed to the alcohol, more solubility was shown. If the alcohol containing asphalt was heated, to increase the solutive action of the alcohol, the asphalt melted and run together, greatly lessening such action.

To meet these difficulties the following course of procedure was tried and gave complete success:

Dissolving the sample, preferably in chloroform, filtering the solution to remove all dirt, etc., one has only clean asphalt to deal with, which in subsequent operations is a very great convenience. The chloroform (or other solvent) is distilled off, until the quantity of the solution is just sufficient for the next step in the procedure.

A strip of clean muslin, having an area of about 100 square inches, is expertly dipped in the solution, and quickly withdrawn so as to dry, leaving a uniformly distributed film of asphalt covering all the texture. This film can be made so as to have a thickness of one to three ten thousandths of an inch. The writer has prepared these films on strips of wire gauze, but prefers muslin ones. When duly air-dried, the strips are put into a drier and kept there until no trace of the solvent can remain.

Thus prepared one has a preparation of asphalt in form that the solvent strength of alcohol can readily take effect. The strips are put into flasks, covered with alcohol, and if the trial is to be one of

cold treatment, the flask is set aside in a dark closet and left standing the desired time. The quantity of alcohol should be one litre to the gram of charge. If the treatment is to be one of boiling, the quantity of alcohol can be less.

The writer has continued the boiling through a term of seventy hours, and observed that solution was still going on. This experience, with many others, established the necessity of prescribing a time period during which asphalt may be tried in alcohol for purposes of comparing one asphalt with another. The writer's practice is to treat with cold alcohol 24 hours, with boiling alcohol 3 hours, these limitations being based on observations which showed that there were changes in the rates of diffusion from hour to hour at approximately definite periods of time. In such trials the weight of extracted material from the samples was specifically determined at the end of each successive hour for ten hours. It was thus demonstrated with reasonable certainty that the alcohol dissolves out from an asphalt two distinctly characterized groups of hydrocarbons, for each of which there is a definite rate of diffusion. Each has its characterized degree of viscosity, and effects conditions in the physical properties of asphalts.

The writer observed early in these investigations that a small quantity of dissolved asphalt saturated a cold alcohol. Thus a solution effected with boiling alcohol, which while hot is bright and clear, quickly becomes cloudy, even muddy looking, when the alcohol is cooled. If the bottle containing this is left standing, a reddish-colored, powdery-looking sediment is precipitated. If the solution is filtered one obtains a clear, bright solution, and holds on the filters a precipitate which is gathered with chloroform or other suitable solvent, and recovered as a portion of the asphalt possessing its own special characteristic properties.

Concerning these groups of component elements of all asphalts the writer has gathered much information which in due time may be published.

The writer's practice is to divide that part of a sample which is not dissolved in alcohol, either cold or hot, by treating it with ether, thereby obtaining an ether-soluble, and gathering into one portion whatever is remaining, as a chloroform-soluble.

By treatment above described, an asphalt is readily partitioned

into four groups of hydrocarbons. He assumes, hypothetically, that there is a special structure of the molecules of combined or compounded hydrocarbons which enter into the composition of all asphalts; and that the molecules of each of the above provided groups partake of this "asphalt structure," and hence thinks that the naming of these separable groups of an asphalt should bear a designation which recognizes their relationship.

The group obtained by precipitation in alcohol has the greatest cohesive strength of the four. The ether-soluble is strongly characterized by its vitreous fracture, at even so high a temperature as 176° F., while the chloroform-soluble is unmanageable at any temperature which can be used in the kind of tests used by the writer. It carries the least percentage of hydrogen in its composition, and but for the use in another connection of the name coal asphalt, could properly be so called. It is suggested as a conclusion reached in these investigations, that very appropriate names for the four groups of asphalt components obtained as above described would be as follows:

Treatment with cold alcohol 24 hours, gives oleo-asphalt; with boiling alcohol 3 hours, gives as a precipitate cementitious-asphalt; with boiling ether 2 hours, gives vitreous-asphalt; with chloroform to the finish, gives carbo-asphalt.

DOLPHUS TORREY. Biographical sketch in April Number, 1893, page 195.

Other methods of fractionating an asphalt are numerous, but on the whole they seem to be less desirable to follow in industrial investigations. Any man with good education can readily effect the fractionating herein described, and with little difficulty make desired contributions to the work of determining the physical properties of asphalts.

Dolphus Torrey.

CAPT. TORREY'S REPLY TO PROF. DE SMEDT.

As a preface to what follows, it should be said here that the writer has not controverted Prof. De Smedt's declarations about asphalts with any view to a personal contradiction, and must not be so understood. The facts, as viewed by the writer, are that

there has grown up in time a mass of traditional opinions in the matter, which opinions are without reason, and are fit subjects for overthrow. The article in the November number of this magazine, by Prof. De Smedt, was the first of its kind offering an opportunity to start a discussion of this kind, and while his name comes in prominently as a part of the text, it should be understood that it is so in the nature of a vicarious atonement for the assumptions of many persons. The method announced in the April number of this magazine, for determining viscosity or cohesive strength of asphalt samples, together with the method of fractionating by solution into several well defined groups, certain component parts of any asphalt given above, marks a change, which will, no doubt, be acceptable to all investigators. It enables one to get more nearly than ever before to some comprehension of the physical causes of certain differences in asphalts, which differences are yet beyond the acquisitions of chemistry. When chemists can formulate the structure of an asphalt molecule, and still more so, when they do so for the approximately defined groups of its subordinate components, the time will have come for more substantial advance in this line of research. Until that time arrives, the work will be quite closely confined to nearly pure physical research.

In the preceding article, the process for conveniently and quickly determining the degree of solubility of any asphalt in alcohol, either cold or hot, is given to enable any one interested to make a trial for himself. The writer has not yet effected a complete extraction of the alcohol soluble from a sample. It is done with approximate completeness in three hours' boiling, but is yet continuing at the end of seventy hours' trial. It appears to be very probable that in time the alcohol will extract its solubles so completely that nothing will remain for ether to attack. In two recent tests of a paving cement made with Trinidad asphalt, there was 56 per cent. of the soluble bitumen extracted in three hours, and from the depleted samples additional extracts are now being made with cold alcohol. With this demonstration the statement of Prof. De Smedt, that a desirable asphalt should not contain more than three per cent. of components soluble in alcohol is effectually disposed of. He says "it must not yield less than 77 per cent. of petroline," that is the component dissolved in ether, and "not contain over 20

per cent. of asphaltine." The proven degree of solubility in alcohol determines that the stated percentage of petroline, as determined by successive solution in alcohol and ether, does not exist in any of the kinds of asphalt in use, and so that requirement is disposed of.

Viscosity in an asphalt is, according to Prof. De Smedt, a property of its petroline. But then viscosity is another term for cohesion, used in describing fluids. Thus it comes that he claims that both the adhesive and the cohesive properties are due to petroline; and this being so understood, it is pertinent in an investigation to understand what function in an asphalt is served by the retine and asphaltine groups of its components.

As to the effect of more than 20 per cent. of asphaltine, the writer possesses a series of analyses of paving cements, made some two years ago at the laboratory of a chemist in good repute, and well experienced with asphalts, which include cases of so-called asphaltine, obtained after ether, running as high as 26 per cent.; and the writer found by analysis as much as 40 per cent. of asphaltine in an asphalt used in one of the most durable pavements ever laid in this country. The facts are to the effect that skill in mixing and laying pavements is of much greater importance than minor differences of asphaltine, and there is good evidence to the effect that an excess over the 20 per cent. of asphaltine conceded, is not inconsistent with good paving asphalt.

Prof. De Smedt says, "It has been often proved that an asphalt yielding an excess of asphaltine is not fit for asphalt pavements, and that an asphalt having lost its petroline, by evaporation or otherwise, its good quality can not be restored by the admixture of heavy petroleum oil." Suppose one adds maltha to it, what then?

Prof. De Smedt says, "It must not contain a large percentage of organic matter not bituminous," which means nothing without some indication as to what percentage is a large one. When that is stated, something can be said for or against it. Again Prof. De Smedt says, "It must not be soluble in caustic potash or soda." Does this mean wholly soluble, or to what extent so? If it means not to be in anywise soluble, what asphalt now in general use is available for paving work?

Prof. De Smedt says, "Preference should be given to the purer article, everything else being equal." Is this to be applied to mat-

ters of cost to the contractor, or does it mean that it possesses preferable physical properties? If the latter, it is desirable to have them specifically set forth.

We are informed that the analyses were made with *chemically pure* asphalts. Such an asphalt the writer has never seen, knowing it to be so. Mr. Clifford Richardson, inspector of alphalt and cements of the District of Columbia Government, in a report dated October 1, 1890, devotes considerable space to the discussion of the impurities of Trinidad asphalt, and names something like twenty impurities found in the water of the stills, where, the water evaporating, these impurities are left in the refined asphalt. Now, a chemically pure asphalt is one freed from all these substances. How it can be done without decomposing the asphalt one can hardly comprehend. It will be a great favor to all investigators if Prof. De Smedt will tell, through PAVING AND MUNICIPAL ENGINEERING, how they may do it. Aside from these many impurities it is desirable information to know how to remove all the sulphur alone, unless that is included as an elementary part of any asphalt.

It was observed in a former article that Prof. De Smedt gave no nitrogen or oxygen as in the composition on asphalt according to his analysis, to which he says, "as a general fact the nitrogen is eliminated as ammonia during the operation of refining." "In Trinidad and Bermudez asphalts no oxygen is found, *provided they are free from all impurities*—water, salts, oxides, etc., etc.," to which the natural inquiry is, are they ever free from these impurities? If not, then they should be represented in analyses. But we have the asphaltine in the asphalt, and this component, first described and named by Bousingault, was given by him the formula $C_{20}H_{32}O_3$; Gerhard prefers $C_{20}H_{30}O_3$. Then we have the asphalt oil as a constituent of all asphalts, and of this Watts' Dictionary of Chemistry says "asphalt yields by dry distillation a yellow oil consisting of hydrocarbons mixed with a small quantity of oxidized matter. It begins to boil at 90° C., but the boiling gradually rises to 250° C.," and "gives by analysis about 87.5 per cent. of carbon, 11.6 of hydrogen and .9 per cent. of oxygen." Watts gives the analyses of half a dozen asphalts by Bousingault, Ebelman and Regnault, all of whom find both nitrogen and oxygen in them.

In the sixth edition of Dana's Mineralogy, a few pages of space

are given to a description of "Oxygenated Hydrocarbons" wherein the name retinite is applied as a generic title to a variety of resinous mineral substances containing little or no succinic acid. In its appropriate place the book defines asphaltum as "a mixture of different hydrocarbons, part of which are oxygenated" and says "the fluid kinds change into the solid by the loss of a vaporizable portion on exposure, and also by a process of oxidation, which consists first in a loss of hydrogen, and finally in the oxygenation of a portion of the mass." In naming the classes of ingredients present in asphaltum the book says "C. Resins soluble in alcohol."

Thorp's Dictionary of Applied Chemistry describes retin asphalt as a resin of which one analysis gave 59.20 per cent. soluble in alcohol, with a formula $C_{40}H_{54}O_6$, and was by Johnson, in 1840, called retinic acid.

The name asphaltine was given to the remaining portion of asphalt obtained from Bechelbrunn, left after distilling off the oils for forty-eight hours at 250° C. The name applied to the substance so obtained should, according to well established usage, be retained for it, and not applied to anything different, obtained in some other way, and not having the same composition. The writer has not intended to criticise any one specially for the use of this word, but simply to call attention to what is thought to be bad practice.

Nothing said by the writer can by any reasonable interpretation be made to cover the imputation that "all asphalts are suitable and alike, good for asphalt pavements, provided they have been refined and tempered with petroleum oil to a certain consistency." It would take too much space here to discuss this matter, but something is to be said in the future. The writer said, "refined asphalt being in an artificial *state* as a result of refining," was by some misapprehension of Prof. De Smedt's, converted into "that an asphalt is artificial after it is refined" and duly commented on. The difference is too great, both in reason and sense, to call for other correction.

Finally, as to the possible effects of impurities found in asphalt, the writer said, "it is probable that the [natural] mineral ingredients confer excellencies for use superior to anything obtainable by the artificial admixture of sand and dust rendered necessary by their absence from an asphalt in its natural state." This view has

some foundation in theory, and the facts can be determined with suitable apparatus possessed by the writer. If Prof. De Smedt will prepare half a pound of paving cement with Bermudez asphalt, made to contain the same percentage of insoluble dust, and of the same degree of softness as a like sample without added dirt, made of Trinidad asphalt; also samples of the same degree of softness, but of customary purity; all samples to be made and agreed upon by two competent parties, say, Prof. Bowen for the Barber company, and himself for the Bermudez company, the writer can make tests which will satisfy any disinterested party as to the facts of the case.

FINIS. *Dolphus Torrey.*

THE FUSIBILITY OF CLAYS.*

In connection with the investigation of the clays of Missouri, a large amount of experimental work has been done for determining their fusibilities and other properties. The following considerations are the outcome of this work:

Bischof, in his "Feuerfesten Thone" (p. 71), gives a formula for calculating the fusibility of a fireclay from a chemical analysis, which is based on the statements that the pyrometric value depends on:

1. The relation of the alumina to the fluxes (or detrimentals).
2. The relation of the alumina to the silica.

From this he derives the following expression for representing what he calls the "Feuerfestigkeitsquotient," or fusibility quotient: $\text{F. Q.} = \frac{\text{Alumina} \times \text{alumina}}{\text{Silica} \times \text{fluxes}}$. The value of F. Q., he finds to be 14 for the most refractory clays (Saarau, with 1.26% of detrimentals); about 9 for pure kaolins (Zetlitz, with 2.00% fluxes), 4 for Belgian fireclays (3.0% fluxes), and 1 or less for the Rhine fireclays, which have 4 to 7% of detrimentals. From Bischof's statement it follows that the more aluminous a clay is the more refractory it will be, while the more siliceous or the more impure with detrimentals the less refractory it will be.

While high alumina is indicative of purity in a clay, yet the work on Missouri clays shows no loss in refractoriness when the

*Published with the approval of Arthur Winslow, State Geologist of Missouri.

alumina is replaced by sand, or the clay is very siliceous, while every increase in the detrimentals decidedly affects the fusibility, especially if the increase is in the alkalies. But the work on the Missouri clays shows that density and fineness of grain have also a very important influence on the refractoriness, and these must be considered in weighing the value of the detrimentals present in a clay. Hence Bischof's formula will be totally unreliable, even in clays of similar density and fineness, on account of confusing the silica and alumina as such vital factors of fusibility, when it is mainly, if not entirely, a question of fluxing impurities, density and fineness. When clays are similar in density and fineness, the refractoriness will be inversely as the detrimental impurities, when the latter are equated as to their proper fluxing values, and if this is called the "fusibility factor," it may be expressed by the following formula:

$$\text{F. F.} = \frac{N}{D \times D'} \qquad (A)$$

in which N represents the sum of the non-detrimentals or total silica, alumina, titanic acid, water, moisture and carbonic acid; D represents the sum of the detrimental impurities, or the iron (as sesqui-oxide), lime, magnesia, alkalies, sulphuric acid, sulphur, etc.; D′ represents the sum of the alkalies which have been found to have about double the fluxing value of the other fluxes; ferrous oxide is probably about as objectionable, but as it usually oxidizes up into much less fusible form of sesqui-oxide in the operation of burning the clay, it is not thus accented in ordinary coarse clays. This formula will be found to give a fairly good comparative value of the refractoriness of clays that do not differ more than 0.2 from one another (the closer the specific gravity, the more reliable the comparison) in density, and are of similar fineness of grain. When the clays to be compared differ in density and fineness, then it is necessary to modify formula A by a constant, C, that will have different values depending on the density and fineness, so the formula will be:

$$\text{F. F.} = \frac{N}{D \times D' \times C'} \qquad (B)$$

in which N, D and D′ will have the same values as in formula A; C=1 when the clay is coarse grained and specific gravity exceeds 2.25; C=2 when clay is coarse grained and specific gravity ranges

from 2.00 to 2.25; C=3 when it ranges from 1.75 to 2.00; C=2 when the clay is fine grained and specific gravity is over 2.25; C=3 when it ranges from 2.00 to 2.25; and C=4 when it is from 1.75 to 2.25. These values of C are only crudely approximate, as not enough work has been done on a sufficiently large variety of clays to give satisfactory values, while no simple method has been, as yet, arrived at for giving a ready and correct expression of the fineness. Still, enough work was done to show that formula B is the only one that can be used indiscriminately on all kinds of clay, though a very large amount of work has still to be done to arrive at more reliable values for C and the fineness, as the large number of factors involved makes it a very complex question.

In the table of analyses given herewith examples have been selected from the 110 samples of the Missouri clays that have been completely studied, which fairly illustrate the unreliability of Bischof's formula the quite satisfactory comparative values given by formula A on clays that are physically similar, and the much more general scope of formula B, which considers physical as well as chemical influences, though it also shows the need of further work to obtain more reliable values for the constant C. Thus, in the St. Louis fireclays, which are all obtained from the same seam, Bischof's formula gives about equal values (1.23 to 1.44) to clays of very different fusibility, and very different values (1.08 to 3.44) to clays of about equal fusibility; the Cape Girardeau kaolin (91.05% SiO_2 and 1.27% fluxes) is given a very inferior value for its refractoriness (0.2), though (as the analysis would indicate) it could not be affected by the highest heat of the furnace, while the easily fusible Winona kaolin is given a higher value (1.5). Again, the Clapper (potter's) clay, which is one of the most, if not the most, refractory clay known, is given a value of only (3.7) by Bischof's rule, while the readily fusible Owensville fireclay has a value of 4. A further study of the table will show the utter unreliability of Bischof's F. Q. as a means of arriving at the relative fusibility of clays.

The table shows that the value of F F should exceed 12 when calculated by formula A, for coarse, very dense clays, or exceed 10 when using B, for a refractory clay; and the higher the value, the more refractory it will be. It should be remembered in consulting

TABLE SHOWING THE VALUE OF CALCULATED FUSIBILITIES.

NAME.	$Si O_2$.	Al_2O_3.	H_2O.	Total N.	Alkalies D'.	Total D.	Sp. Gr.	Grain.	Fusibility, F°. Incip.	Complete.	Scor.	Calculated Values. Bischf. F. C.	Wheelers A.	Wheelers B.
St. Louis Fireclays:											ab've			
Christy, washed	64.35	21.16	8.94	94.45	0.51	4.81	2.13	Fine	2200	2400	2700	1.44	17.7	13.0
" mine run	61.73	23.56	9.25	94.54	1.00	7.30	2.47	Coarse	2100	2300	2500	1.23	11.4	10.2
Jameson's, washed	58.61	27.36	11.13	94.10	0.71	5.25	1.92	"	2200	2400	2700	2.47	15.8	11.8
" mine run	53.90	28.85	11.61	94.36	0.85	6.86	2.40	"	2200	2400	2600	2.38	12.2	10.9
Sattler, washed	52.98	28.77	11.42	93.17	1.01	5.12	2.40	Fine	2200	2400	2700	3.44	15.2	11.4
" mine run	51.66	30.78	11.86	94 30	0 99	5.88	2.40	"	2100	2300	2500	3.06	13.7	10.6
Parker & Russell	67.47	19.33	7.73	94.53	1.07	5.14	2,44	Very coarse	2250	2450	2700	1.08	15.2	13.3
Laclede	57.34	24.68	11.55	93.57	0.67	6.30	2.45	Coarse	2250	2450	2650	1.69	12.9	11.1
Evans & Howard	59.36	23.26	10.20	92.82	0.63	5 67	2.41	"	2250	2450	2650	1.64	12.7	11.3
"Rock" or Non-Plastic Fireclays:											over			
Pendleton	46.18	38.12	14.01	98.31	1.20	1.06	2.42	Fine	2300	2500	2700	16.	28.	18.
High Hill	45.12	40.46	13.34	98.92	0.30	1.06	2.33	Very fine	2350	2550	2700	37.	73.	29.
Drake	40.50	43.22	14.15	97.87	0.51	1.93	2.35	"	2300	2500	2700	23.	40.	22.
Truesdale	43.56	41.48	14.05	99.09	0.20	1.00	2.45	"	2300	2500	2700	40.	82.	31.
Union	44.14	39.86	13.84	97.84	0.76	2.45	1.98	Fine	2200	2400	2700	15.	31.	18.
Owensville	44.70	35.92	12.62	93.24	0.29	6.85	....	"	2050	2200	2350	4.	11.	9.
Sankey's	50.18	33.02	11.88	95.07	2.06	5.29	2.10	Coarse	2100	2300	2500	4.	13.	10.
Kaolins:														
Glen Allen	72.34	18.94	7.04	98.28	0.42	1.89	1.89	Very fine	2200	2400	2600	2.7	42.	15.6
Sterling	57.75	27.60	11.43	96.78	0.60	3.24	....	"	2200	2400	2600	4.3	26.	12.3
											ab've			
Cape Girardeau	91.05	5.01	2.74	98.80	0.12	1.27	2.02	"	2200	2400	2600	0.2	70.	22.
Winona	56.74	27.29	7.40	91.43	1.21	8.52	1.86	"	1800	2000	2200	1.5	9.6	7.
Potters' Clays:														
Guthrie	47.13	34.98	13.88	95.99	0.52	3.76	2.13	Very fine	2000	2200	2400	6.5	22.	13.
Mammoth	49.04	34.85	12.33	96.22	0.85	3.93	1.69	"	1800	2100	2400	6.3	20.	11.
Commerce	71.78	17.01	8.13	96.92	0.78	3.56	2.03	"	1950	2150	2350	1.0	22.	13.
										over	over			
Clapper	67.76	21.96	8.23	97.95	0.24	2.13	2.45	Coarse	2500	2600	2600	3 7	46.	27.
Deepwater	74.02	15.26	3.69	92.97	2.37	5.38	2.37	Fine	2100	2300	2500	0.6	12.	10.6
Brick Clays (Loess):														
Kansas City	72.00	11.97	6.42	90.19	3.25	10 11	2.17	"	2000	2200	2300	0.2	6.8	5.7
Hartwell	60.93	21.51	5.30	87.64	2.03	10.15	1.80	"	1850	2050	2150	0.7	7.2	5.4
St. Louis	73.92	11.65	5.26	90.83	3.13	9.90	1.98	"	1800	2000	2100	0.2	6.8	5.3
Shales:														
Moberly	65.01	19.34	6.54	90.85	2.60	9.31	2.41	Coarse	1850	2050	2250	0.6	7.5	7.0
Kansas City	54.80	23.73	6.00	84.53	3.80	15.34	2.37	Very fine	1500	1700	1900	0.7	4.4	4.0
Deerfield	58.90	21.38	8.69	88.97	1.52	10.84	2.43	Medium	1800	2000	2200	0.7	7.3	6.5
Louisiana	57.01	24.43	7.63	89.07	3.81	11.47	2,39	Coarse	1600	1800	2000	0.9	5.8	5.5

the table that no matter how reliable a pyrometer may be—and the best of them need much care and attention—it is difficult to determine just what the temperature of a clay is, when it begins to change, on account of its very poor conductivity of heat; differences of over 100° F. were found within less than half an inch on the same bricklet. In burning a clay, it slowly shrinks and becomes harder as the temperature is raised above a red heat (when it begins to lose its chemically combined water), and at a certain point the granular structure of the raw clay can no longer be distinguished, and it is now found to have a hardness of 6.0 to 6.5; this is called the point of incipient vitrifaction (in the table), or fusibility, and it is necessary to burn clay wares to this point to develop strength and

hardness. If the temperature be raised still higher, it will become slightly harder, or 6.5 to 7.0, and at a certain point will look more or less stony or vitreous, which is called completely vitrified; at this point the clay will not soften or flow or become distorted. If the heat be still further raised, the clay will finally soften, vesicles and bubbles will begin to appear as the result of gases given off by the chemical changes that now slowly take place, and finally a very spongy, scoriaceous, pasty mass will result, unless the heat be raised so high as to thinly liquify the mass, when the gases escape and a pool of glass results. The first appearance of the bubbles is called the point of scoriaceous vitrifaction, or fusion, and shows that the clay is failing and would slowly flow or yield under pressure or abrasion. As the range in temperature is usually from 300° to 600° F. between this first or incipient point and last or scoriaceous or failing point, with a gradual transition from one to the other, it is difficult to state with any degree of accuracy just when the clay falls, and to decide any closer than a rough approximation as to when a clay gradually passes through the above three important stages in its very slow transition from a rigid solid to a very viscous liquid. Hence the pyrometric determination of these three conditions is only approximate and an error of 25° to 50° in the figures given in the table is quite possible.

Le Chatelier's thero-electric pyrometer was used in making the temperature observations, which was calibrated to show changes of 25° F., and the samples, varying from ½ in. by 1 in. by 4 in. to 1 in. by 1 in. by 4 ins., were burned in muffles and graphite crucibles that were run at different degrees of heat in coke fired assay furnaces. *H. A. Wheeler.*

METHODS OF SEWER CONSTRUCTION.

WATERTOWN, N. Y.

WITHOUT good reason to the contrary, the sewers are constructed in the center of the streets. Stakes are driven every fifty feet at a suitable distance from the center line, depending on the width of the trench to be opened; generally, however, five feet from the center line. As the stakes are, especially in rock, liable to be destroyed,

a secondary parallel line is run on the sidewalk and marked by a nail driven through a round tin. Levels are taken on the top of the stakes and the cut from the top of the stakes to grade is given. When the trench has been excavated to the required depth a grade is then given by which to grade the bottom of the trench and with which to lay the pipe. This grade is given in the following way: Every twenty-five feet a plank is firmly fixed across the trench. There are various ways of fastening the plank. One way is to pick a slot in the sides of the trench and sink the plank edgewise in the ground. Another way is to load the ends of the plank with earth or broken rock. To this plank is nailed an upright strip, one side of which is on the center line. If the trench is more than nine or

COOPER STREET OUTLET ON LE ROY STREET, LOOKING NORTH.

ten feet deep a second cross plank is placed lower down to support the upright strip. On this strip is made a mark which is a convenient number of feet, generally seven above grade. In a similar manner the other grades are set. A line is tightly drawn between the grade boards at the same height as the marks on the upright strip and on the side of the upright strip that is centered. This line is the center line and is seven feet above grade.

By using a measuring pole seven feet long and the thickness of the pipe, the bottom of the trench is brought to a true grade. The measuring pole by which the pipe is laid has a right-angled projection which, when in use, rests in the bottom of the pipe. The

point seven feet above grade is marked by a nail which sticks out of the measuring pole about one inch. The pipe is raised or lowered until the head of the nail touches the line.

The pipe is laid in the center of the trench by plumbing down from the center line. A variation of one or two inches is not considered injurious to the pipe line. The width of the trench at the bottom for pipe smaller than twenty inches is eighteen inches wider than the exterior diameter of the pipe to be laid. For pipe larger than eighteen inches twenty-four-inch pipe is called for.

This space is necessary in order to cement the bottom of the pipe. In cementing a twenty-four or thirty-inch pipe there must be room for a man's body between the pipe and a side of the trench and even then he can not reach more than half way under the pipe. It also allows the men to walk beside the pipe without disturbing them. Although the specifications prescribe this width there are times when it is not rigidly followed.

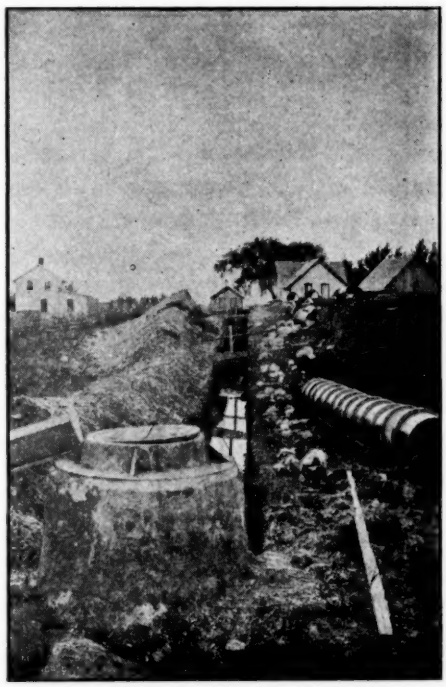
In rock trenches there are sometimes places met with where it is not necessary to take the rock out to the full width. At the bottom, the rock may be within six inches of the pipe on one side of the trench, while a foot or two higher up the rock has been blasted out so as to leave ample room to cement the pipe; or there may be a perpendicular wall on one side within six inches of the pipe and plenty of room on the other side. By taking pains at these points the pipe is laid and cemented as well as elsewhere, and the contractor is saved the expense of widening out the trench, which might amount to a good many dollars. Almost always the rock trench is wider than the width called for.

Before each pipe is laid a bell hole is dug large enough to admit the bell and to leave a space of from four to six inches in front of the bell. This space leaves room for the hand in cementing the pipe. A tarred jute is used as a packing to partly fill the bell. The jute is cut in pieces long enough to reach around the pipe and lap three or four inches. A number of strands sufficient to fill the space between the spigot and bell a quarter or a half way to the front of the bell are used. The jute is used as a rope to lift the pipe so that the socket may enter the bell. The jute is placed at the spigot end and when the spigot is entered into the bell the jute at the bottom is carried in the bell with the pipe. The jute is then

calked in with the calking iron. The space between the spigot and the bell is not always uniform, so the amount of jute required in each pipe varies to some extent.

In cementing the pipe the space in the bell not filled with jute is filled with cement, and the cement is extended out beyond the bell two or three inches and is then beveled up to meet the bell. The cement used is a quick-setting Portland mixed one to one. It will set so that it can not be crowded off the joint in from sixty to ninety minutes.

Before the back-filling is permitted the pipes are inspected to see that the joints are not cracked, that the cement is on the bottom, and that it has set sufficiently hard. The back-filling, until above the pipe, is made of fine material. In the case of small pipe, and where the cut is deep, the back-filling is not thrown directly on the pipe, but on the portion already covered, and is then shoveled ahead around the pipe. This prevents the pipe from being disturbed.



COOPER STREET OUTLET, LOOKING WEST FROM THOMPSON STREET.

Man-holes are built from two hundred to six hundred feet apart; the location of the man-hole depends on the intersecting streets and the change of grade. The walls are built of brick and are eight inches thick. The bottom is made of concrete. The sizes vary from 3.5 feet by 5 feet to 4.5 feet by 6 feet.

A lamp-hole is generally built between each man-hole. Five-inch branches are used for house connections. The connection is laid to the curb line. All specials are located by measuring the distance from the range of the most convenient house to the special. The elevation of each Y branch and of the end of the lateral is also recorded.

All data relating to the specials is recorded in columns ruled for the purpose in the back of the field book.

The following table shows the manner in which they are recorded:

LOCATION OF SPECIALS.

For House No.	Location of Special.				Station of Special.	Elevation of Special.	Location of end of Lateral.				Station of end of Lateral.	Elevation of end of Lateral.	Elevation of Cellar Bottom.	No. of pipe in Lateral.
	Ft.	Of		No.			Ft.	Of		No.				
High St. 5	12.0	E.	W.	5	182.2	96.05	1.8	W.	E.	5	189.5	97.61	98.42	8
9	10.9	W.	E.	9	278.1	96.85	Not	laid.	....	....	....	....	....	..
10	2.4	W.	E.	9	286.6	97.22	1.0	E.	E.	7	294.7	98.12	98.96	10
Lamp-hole	30.4	E.	E.	9	329.4	....	....	....	....	....	....	....	....	..
12	3.6	W.	E.	12	338.4	97.60	4.2	E.	E.	12	346.2	98.92	100.20	9
Man-hole	8.4	W.	E.	16	442.0	....	....	....	....	....	....	....	....	..
Vacant lot on R. R.	12.2	W.	W.	21	648.4	102.80	7.9	E.	E.	22	656.4	104.12	....	10

The letters E. and W. indicate whether the measurement is east or west of the house and from the range of which side of the house, the east or west, it is taken. In case the sewer ran north and south, the letters N. and S. would be used.

Each sewer has a leveler and a rod-man whose whole time is spent on the work. Their duties are to stake out the line, give cuts, cross-section rock where encountered, inspect the pipe and match the larger sizes; give grade to lay pipe, inspect the pipe laying, obtain information from property owners where they want their laterals; see that the specials are laid at the proper place, take the elevation of Y branches, inspect the pipe before they are covered, stake out man-holes and laterals; inspect the building of man-holes and the laying of laterals; measure the length of the sewers. Work generally moves at such a rate that the leveler and rod-man have plenty to do. If the sewer is in rock and moves slower, they are transferred to other work. *Fred E. Avery.*

FRED E. AVERY was born January 25, 1864. He was graduated from the Watertown High School in 1883 and entered the employ of Hinds & Hodgkins in August, 1883. Mr. Hodgkins was then city engineer of Watertown. He taught school the winter of 1883–4 and entered the employ of Hinds, Moffett & Co. in the spring of 1884, and continued with them until the spring of 1886, and spent the season of 1886 with the Carthage and Adirondack R. R. Co. on the engineering force. In 1887 he entered the employ of T. A. Hinds, who was city engineer, taking charge of sewer construction, and remained with Mr. Hinds during 1887–8. He then entered the employ of Mr. Pecke, who was city engineer in 1889. In 1890 he was appointed city engineer by the council and was reappointed in 1891. In May, 1891, the board of public works was created and he was appointed city engineer by them, and has held the office ever since.

THE VALUE OF GOOD ROADS.

THE good roads movement is not a fad. Because of its age, its attainments, and its vitality, it is no longer fairly subject to the suspicion or the sneer of the conservative.

During the latter half of the last decade Col. Albert A. Pope, of Boston, persistently brought the subject to the attention of conventions of carriage makers and of others with like interests. There was other spasmodic agitation here and there. The movement, as such, was started two years ago by a partially successful effort to secure a comprehensive road exhibit at the World's Fair. In December, 1892, the "National League for Good Roads" was formed at Chicago. At its Washington meeting, January, 1893, it secured the establishment in the Department of Agriculture of the Bureau of Road Inquiry, whose purposes are: To make inquiries in regard to the systems of road management throughout the United States; to make investigations in regard to the best methods of road-making; to prepare didactic publications on this subject suitable for distribution; to assist agricultural colleges and experiment stations in disseminating information upon this subject. A bulletin containing the results of the bureau's work during 1893 has just been issued.

A few weeks ago Senator Hoar presented a monster petition with 150,000 signatures asking the establishment of a department of road-building which would extend the work of the present bureau.

Highway commissions have been provided for by the legislatures of a half-dozen states. Of course there is one in Massachusetts, and of course it is composed of experts—two of the three being Harvard professors. They do things that way in Massachusetts.

Successful road congresses have been held in nearly half the states. New laws, more or less radical in their character, were enacted in twelve states during 1893, and nearly all the others are moving in the same direction. The movement has made its most notable progress in Massachusetts, Vermont, New York, New Jersey, Maryland, Pennsylvania, Ohio, Indiana, Iowa and California.

"It is doubtful," says a writer in a recent magazine, "if in any country a social or economic question has ever so swiftly and effectively been brought to the attention of the people. In about three

years our people have passed from an attitude of indifference to a state in which they not only desire improvement, but begin to see their way as to the methods by which they may gain the end. This rapid progress has been due mainly to the effective manner in which the press has supported the endeavors of those reformers who have undertaken to deal with the matter." Such in very meager outline is the history of the movement.

The success thus indicated suggests the timeliness of the movement. Why is it timely? The answer seems plain. Between 1820 and 1840, contemporaneously with the good roads movement in England, our common roads, particularly those radiating from markets, were much improved under the stimulus of a growing appreciation of the need of facilities for the movement of people and things. Considerations of public defense and of the mail service, as well as those of commerce, were elements of this appreciation. During this period national road building occupied the attention of Congress, whose duty it had been declared to be to "bind the republic together with roads and canals." The movement toward cheaper and easier wagon transportation was progressing tellingly when the use of railways withdrew the minds of our people from the dirt ways. They came quickly to regard the former as the future means of transportation. Enthusiasm for the development of the longer wagon routes disappeared in the eagerness—it has been called a mania—for railroad building. The common road came to be looked upon as a matter, no longer of national or of state, but of solely local concern. Its construction and maintenance were for the most part turned over to, and have since remained in, the control of the farmer, with the result that its average quality the country over is not now as good, according to the testimony of Professor Shaler and all other authorities, as it was fifty years ago. Meantime the development of our railroad system, with national and municipal aid, went forward with wonderful vigor to the close of the last decade, when, nearly 200,000 miles being in operation, it seemed to reach, for the present at least, its culmination. We are proud of this accomplishment and yet can afford to pause with so sober-minded a man as Professor Shaler, of Harvard, and consider his statement that: "A very strong argument could be made to support the point that the United States would have been in all es-

sential regards more prosperous than it is at present if, in place of its railways, it had secured a system of highways constructed and maintained in the highest state of the road-maker's art."

In this connection I will quote, as confirmatory of Professor Shaler's proposition, the following from the report to our State Department of Mr. Francis B. Loomis, commercial agent at St. Etienne: "The road system of France has been of far greater value to the country as a means of raising the value of lands, and of putting the small peasant proprietors in easy communication with their markets, than have the railways. It is the opinion of well informed Frenchmen, who have made a practical study of economic problems, that the superb roads of France have been one of the most steady and potent contributions to the material development and marvelous financial elasticity of the country."

However desirable or undesirable it might be to exchange what we have for what we have not, it is becoming very clear that railways, far-reaching though they are, and efficient and invaluable in inter-state and international commerce, can not be made profitably to fill the need of neighborhood communication. They can not run to every village, much less to every farm. With the realization of this has come the movement for good roads, which I characterized as timely.

The question is not whether we all want good roads—of course we do. It is rather how great is our need of them. How much sacrifice in obtaining them will their importance justify? Then, what additional or different governmental machinery is necessary for their attainment? And finally, how shall they be built?

As to the last question I know nothing. Its answer is the business of the road engineer. And how many competent road engineers do you guess there are in this country? Not more, it is said, than fifty. An effort was inaugurated in 1891 by Col. Pope to secure the introduction in college curricula of courses in road engineering. It has been measurably successful, several colleges, notably Harvard, now offering such instruction.

Over the second question proposed I will delay only long enough to make meagerly two suggestions as to governmental action. The first is that the friends of good roads are unwise, I believe, in their contention for national aid. There is no requirement, postal, strat-

egic, or political, for long wagon routes. The railway efficiently serves all purposes distinctively national. As Mr. Wright, of Rochester, N. Y., has said: "The county is the ultimate unit in road building; in this the community interest is practically complete. It is to and from the county-seat, the town and the railroad station, that all road traffic goes. The area and expenditure is sufficient to secure best engineering skill and road material; and under county management the needs of each locality can be better served and more intelligently, and its operations more carefully guarded. Under county systems, too, each county may enjoy the advantages of its environment or suffer for their lack."

The second suggestion as to governmental machinery is that the present wasteful system of working out road taxes should be supplanted by a money tax; and that this tax should be expended, not under the direction of our present road supervisor, who frequently knows no more about building common roads than he does about building railroads, but under the direction of a county road engineer skilled in the business—a business which is more complicated than that of the railroad engineer. There is no need of increased taxation. Over three million dollars are now, and for many years have been, available for the improvement of Indiana highways. Think of it. More than sixty million dollars have been spent on the common roads of this one state within the last quarter of a century. What have we to show for it? Mud! Mud! Mud! Muddier mud and muddiest mud! A loaded hearse and four horses stuck immovably in the mud of Ohio county's main thoroughfare —that is in the history of Indiana for the year of our civilization, 1893. Likely enough the poor fellow, whose journey homeward was thus impeded, had died while his hastily summoned doctor struggled in the same mud hole. We have yet to learn what Tresagnet learned from the Romans and taught the French a century ago, and what MacAdam and Telford have since taught the English—that a road is a structure and, like other structures, is built one way by farmers and another way by engineers. So much then by way of suggestion as to legislative action—the undesirability of national interference and the desirability of a local money tax expended by experts.

And now as to the first question proposed. What and how

great are the advantages of good roads? Are the advantages such as to make it worth while to work for them?

One of the propositions about which economists are generally agreed is that prices conform in the long run to the cost of production. Transportation is, of course, one of the large elements in the cost of all manner of products. At least a third, perhaps more (for I am only guessing), at least a third of the cost of to-day's dinner was my share of transportation charges prepaid by the farmer and the manufacturer. The price of the wheat in my bread was determined by the cost of production on the farm and of transportation thence, not to my home city, but to Liverpool, the world's wheat market. Any permanent reduction in the cost of that haul from the farm hither and hence to Liverpool will in the long run permanently cheapen our bread. A reduction within the last twenty years of over 200 per cent. in the cost of the railroad and steamship part of the haul has vastly cheapened not only our bread but other commodities as well. Now, what proportion of the whole cost goes to the wagoner, on the one hand, and what, on the other hand, to the railroad and steamship companies? In other words, is the wagon haul too insignificant a part of the whole for any one but a good-roads crank to bother about? The answer is this: To bring twenty-five bushels of wheat into any near by city over ten miles of dirt roads costs as much as it does to take those same twenty-five bushels 4,000 miles to Liverpool. Another answer can be had from the Tenth United States Census, for which an attempt was made to get a fair estimate of the average cost of hauling grain from the farm to the railway station. The returns showed that it costs the ordinary farmer more to carry each bushel of wheat a mile than it does the ordinary railroad to carry a ton. We now have at least an indication of the rate of cost of wagon transportation compared with the rate of cost of railroad and steamship transportation. In connection with this comparison, consider the fact that more than a third (I am still guessing, but not nearly so wildly as before), more than a third, probably a half, in value of the commodities carried by the railways are hauled over our country roads an average distance of four miles. Add to this the countless tons of country road freight which supply the local markets and then agree with me that primary transportation is of direct pecuniary

interest, large interest, too, not only to the farmer and manufacturer who prepay the charges, but also to the consumer, you and me, who repay them. The magnitude of the expenditure and the universality of its diffusion certainly invite consideration by citizens as well as by enthusiasts of the possibility of profitable reduction. It is to that consideration that I now ask your attention.

Professor Latta, of Purdue University, has letters from forty farmers in as many Indiana counties. Without any knowledge as to their opinions on roads, they were asked to estimate the annual loss to them per hundred acres from the lack of good roads. Many, particularly in the counties where the roads are worst, reported no loss. The average of their estimates is $76.25. For the state this means something like $16,000,000 loss per year to the farmer. The result which is thus arrived at on what is, of course, a very unreliable basis of calculation, happens to correspond closely with an estimate made for Illinois by Prof. J. W. Jenks. He gives it as his belief that a full load can be carried on the Illinois roads only three months during the year; two-thirds of a load three months, and one-half a load six months. Good dirt roads would, he says, reduce the cost of hauling in Illinois one-half, and good, permanent macadamized roads three-fourths. The defective highways of the state are estimated to cost it an extra $15,000,000 for farm hauling, and so depreciate the value of its farm lands $160,000,000.

Mr. Rudolph Herring has prepared a table exhibiting the results of his investigations and those of the best engineers here and abroad as to the resistance to traction offered by various surfaces. It can fairly be summarized thus: A horse, which can barely pull a ton over a dirt road in good condition, can pull four tons over a good macadam road, and twenty tons over an iron tramway. With the aid of this ratio we can make another guess at the money loss from hauling over bad roads. From one hundred acres under cultivation at least fifty tons should be sent to market annually. This is only one-third the average in some states. Again, suppose the distance to market to average four miles. It would hardly be possible, would it, to make more than two round trips a day, which at a ton a load would mean twenty-five days of hauling per year? Divide Herring's ratio by two, for safety, and we have, at $3 per day for driver and team, a difference between the cost over a ma-

cadam and an ordinary earth road of $75 per hundred acres annually, or about $10,000,000 for the state. Another method of approaching the problem is this: In Switzerland, "the best highwayed country in the world," one horse serves thirty people. In England, where the roads are admirable, the ratio is one to twenty-four. In France it is one to thirteen and a half. In the United States it is one to four, while in Indiana, one horse serves only three people. Estimating the annual cost of maintaining a horse at one hundred dollars, we find that if our work could be done at even the French ratio of horses to population we would save annually a sum so large that I dare not mention it. If the improvement of Indiana highways, for instance, should mean only that three horses could do over them the present work of four, the annual saving in horse maintenance would be $20,000,000. Still another method has been worked out by Prof. Ely, who estimates that our poor roads cost the farmer $15 per horse.

It goes, I am sure, without the saying, that the estimates given are only the roughest approximations. I have denominated them "guesses," but in conclusion of my effort to indicate the possibility of profitable reduction in the cost of primary transportation, I submit that the guesses are based on facts with sufficient accuracy to win your assent to the following quotations, the first from the report of our consul at Havre, Mr. Oscar F. Williams:

"The cost of highway transportation over the properly built road of France does not exceed one-third the like expense in the United States, it being common in the rural districts of France to haul three tons, and in the cities three to five tons freight net, with one horse."

The second quotation is from an article by Mr. Clemens Herschel, an engineer of Boston, who made a prolonged and careful statistical study of the subject, about which he writes thus:

"The English horse employed in the streets of a city, or on the roads of the country, does twice as much work as the American horse similarly employed in America. This is the patent, undeniable fact. The simple explanation is that the Englishman has invested in perfect and permanent roads what the American expends in perishable horses that require to be fed."

A farmer reader would probably ask at this point: "Why should

I be interested in the improvement of our highways and the consequent reduction in the cost of primary transportation, inasmuch as the benefit of the reduction will, according to your economists, accrue, not to me, but to the consumer?'' The answer, farmer, is that you have not quoted the economists accurately. It is only in the long run that prices conform to the cost of production. Meantime the producer, not the consumer, is the beneficiary of any reduction in the cost of production. Until the improvement of the common roads had become general, indeed all but universal, the farmer would save directly, and for himself, the advantage from cheapened wagon transportation. Of course this saving would increase the value of his farm. How much? The average of the estimates of Professor Latta's forty correspondents is $9 per acre. This means $200,000,000 of enhancement in the value of Indiana farms. Two hundred millions—that is four times an amount which would put the best macadam road both ways over that state every six miles; in other words, four times an amount which would so gridiron the state that at least two-fifths of our farmers would live on unsurpassed macadam roads from which no man could possibly locate himself farther than three miles. Two hundred millions—seven times an amount which would put the best gravel road both ways over the state every three miles; in other words, seven times an amount which would so gridiron the state that at least four-fifths of all our farmers would live on unsurpassed gravel roads from which no man could possibly locate himself farther than a mile and a half.

I am loth to believe it, but possibly the farmers have put their figures too high. Remember, however, that you can divide their average of $9 per acre by seven and with the aggregate of an average appreciation of only $1.30 per acre you can build past four farm houses in five a road as good as that over which you make your ten miles an hour.

An illustration of the appreciation of land values under the influence of road improvement is seen in Union county, New Jersey, which probably has the best system of improved roads in the country. They were built in 1889 and 1890, and were immensely expensive. But already the appreciation of the values of real prop-

erty as shown, not by the prices asked, but by the assessor's books, greatly exceeds the cost.

Dr. Chauncey B. Ripley, speaking of these Union county roads, says: "The roads cost less than 1 per cent. on the valuation of the property in the county. The lowest estimate of advance of real estate by reason of the improved roads is 5 per cent. as to that portion of land used for farming purposes. For other purposes, the lowest estimate of advance is 50 per cent."

One of the reasons for the astonishing advance in farm values which Union county has experienced and Prof. Latta's farmers predict is that farm products which are now marketable only when prices are lowest could be marketed over good roads when prices were highest. Enormous sums of money are annually made by those who buy in the fall when roads are good and sell at monopolistic prices when bad roads have shut off the supply. The wheat crop is hurried to market while the roads are good; the elevators and warehouses are filled; the railroads are blocked, and prices fall to the hog-feeding point—is not this annual history? Do not locomotives stand idle in their stalls, and grain cars empty on the side tracks during many months that they may be used to relieve each fall the congestion caused by the certainty of a mud-embargo during the winter?

One word more as to the economic importance of the subject. We do not realize how vast is our investment of capital in roads. Three of our States, it is said, can be easily selected in which the total length of public roads, exclusive of town and city streets, is greater than the combined mileage of all the railroads in the world. Our common roads are a big investment and the returns from them could be largely increased.

I will not longer strain your credulity by consideration of the economic phases of the good roads movement, but will, in conclusion, turn for a minute to its social phase. We are all familiar with the statistics which show startlingly the movement of population from the country to the cities. A considerable cause of the movement cityward is the isolation of the country life, an isolation which is, I believe, largely the result of difficult communication. The light in the window of a neighbor's house has awakened many a social impulse which would have enlivened and enlarged country

life had it not gone out in a sigh at the thought of the impassable road which must be struggled through to reach the light. The church bell whose tones come across the country to many a farmer's lonely wife, quarantined inexorably by mud, seems as far away as heaven. The Sunday services, the spelling bees, the singing schools, the festivals are not for her or her hermit household. No wonder that so many of them are insane! The farmer is often narrow and suspicious. What is it that begets narrowness and suspicion so easily as isolation?

Good roads would not only help to fill the farmer's purse; they would, according to ex-Postmaster-General Wanamaker, make free postal delivery possible in the country, which would bring the daily paper and its awakening influence; they would mean that his children could get to school six months instead of three or two or no months in the year; that he would not lose his vote when the roads are bad. They would mean a freer human intercourse, quickening his perceptions, broadening his horizon, raising his standards; they would mean that "close and constant interaction of the local life" upon which depends a sound democracy. *Evans Woollen.*

EVANS WOOLLEN was born November 28, 1864, in Indianapolis. He is a graduate of Yale, class of '86. He took the graduate course in political economy in '87 and '88. For a time he was engaged in newspaper work in Indianapolis, and in 1888–89 was secretary and manager of the Natural Gas Company at Wabash, Ind. Since then he has practiced law in Indianapolis, both generally and in the legal department of the Cleveland, Cincinnati, Chicago & St. Louis Railway Company. He has been prominently identified with public-spirited movements in Indianapolis, and is regarded as a writer of ability on economic subjects. He was one of the organizers of the Indiana Highway Improvement Association and since its formation has been its secretary.

CURRENT INFORMATION.

THE OUTLOOK FOR PUBLIC WORK.

Indications for public improvements this year are, in nearly all parts of the country, of a very favorable nature. Owing to the changes that usually take place at this time of the year among the officers of municipalities, it is a little early for all the preliminary steps that necessarily lead to such improvements, to have been made. Two hundred and fifty inquiries, made by PAVING AND MUNICIPAL ENGINEERING in as many different

PLACE OF IMPROVEMENT.	ASPHALT.		BRICK.		MACADAM.		SEWERS.			WATER-WORKS.		BRIDGES.
	No. of square yards.	Cost of improvement.	No. of square yards.	Cost of improvement.	No. of square yards.	Cost of improvement.	No. of lineal feet. Brick.	No. of lineal feet. Pipe.	Cost of sewers.	Length of mains.	Cost of mains.	Cost of bridges.
Huntington, W. Va			20,000	$25,000 00			6,500	8,000	$378,000 00	1,100		
Carbondale, Pa			5,128	11,156 00				3,000	4,650 00			$4,500
Philadelphia, Pa								396,000	2,000,000 00			840,000
Charlotte, N. C					10,000	$15,000		6,000	3,000 00			
Holyoke, Mass							2,640	21,120	105,000 00			30,000
Newcastle, Pa			32,000	51,200 00								
Burlington, Ia			40,000	75,000 00			2,000	15,000	30,000 00			
Freeport, Ill					14,620	10,000						
Muncie, Ind	30,000	$72,000 00										
Allentown, Pa					1,766	1,500						
Atlanta, Ga			19,000	41,600 00			5,000	20,000	55,000 00	26,400	$25,000	
Flushing, N. Y					50,000	30,000						
Arkansas City, Kan					15,000	5,000						2,000
Ashland, Wis							4,862	4,392	30,000 00			
Beatrice, Neb								6,000	4,000 00	5,000	5,500	2,000
Hot Springs, Ark								2,000	2,500 00	10,500	20,000	
Auburn, N. Y							13,000	8,000	80,000 00	179,520	*25,000	
Marshalltown, Ia			16,000	26,000 00								
Erie, Pa	6,097	19,830 40	4,000	9,689 40			1,275	9,052	35,150 00			
Marietta, O			16,228	12,053 12								
Battle Creek, Mich							650	550	2,600 00	5,200	5,000	
Pittston, Pa			35,295	60,000 00			6,040					
Athens, Ga								12,000	12,000 00			
Titusville, Pa								2,056	3,550 00			
Albany, N. Y	9,000	27,000 00						1.000	1,500 00			
Louisville, Ky			150,000	525,000 00			10,450	5,000	60,500 00			
Minneapolis, Minn							22,975	17,123	178,550 00	69,045	103,516	25,000
Nashville, Tenn					31,500	135,000	8,888		30,711 88	6,000	5,000	
Brockton, Mass							2,000	14,000	58,000 00	15,840		
Meadville, Pa							3,700	6.000	15.000 00			1,500
Decatur, Ill			33,000	50,000 00			1,000	10,000	12,500 00	5,000	5,000	3,000
Melrose, Mass								27,154	60,000 00			
West Chester, Pa					8,000	8,000	2,000		2,500 00	800	1,500	
Milwaukee, Wis	100,000						20,000	75,000	200,000 00	130,000	130,000	610,000
Meridian, Miss							5,600	89,760	75,000 00			
Chicago, Ill	39,000	117,000 00	6,000	12,000 00	250,000	225,000	528,000		1,200,000 00	390,720		100,000
Danville, Ill			40,000	75,000 00			5,454	1,375	25,250 00			6,000
Sioux Falls, S. D							696		2,500 00			
Bradford, Pa			1, 00	2,420 00				5,790	3,466 00	11,180	8,288	31,000
Middletown, N. Y	9,000							7,500				
Jacksonville, Ill			3,350	6,000 00				1,320	460 00			
Rock Island, Ill			20,000	32,000 00								
Tiffin, Ohio			25,000	68,000 00				3,000	2,500 00			2,500
Hazleton, Pa								3,500	6,000 00			
Indianapolis	95,066		40,700									
Marion, O				25,000 00		15,000						
Macon, Ga								21,760	110,000 00			
Glens Falls, N. Y											80,000	
Millville, N. J								26,400				
Findlay, Ohio					2,200	12,000						
Bloomington, Ill			17,442	25,720 53			1,440	3,500	3,895 00			
Concord, N. H								6,000	10.000 00			
Ottawa, Ill										123,080	160,000	
Clinton, Iowa								3,000	1,800 00			

*This includes purchase of water-works from company, July 1, 1894.

cities having a population of 10,000 or more, elicited information regarding public work which indicates, generally, that the expenditures of municipalities will be unusually large this year. Of seventy-five responses to inquiries made, fifty-four cities are foremost in the improvements already provided for and confidence is expressed for much more work in all branches of municipal industry. A few of the remaining twenty-one cities have no work in contemplation, but the majority of them speak encouragingly of proposed work upon which action has not yet been taken. The following table gives data received up to the present:

A summary of this table shows the aggregate amount of improvements and expenditures thereof, to be:

Asphalt paving,	288,163 sq. yds	$ 235,830.80
Brick "	524,143 " "	1,142,720.05
Macadam "	383,086 " "	445,700.00
Brick sewers,	646,580 lin. ft	7,065,168.88
Tile "	1,147,950 "	
Water Mains,	948,465 "	573,804.00
Bridges		1,657,500.00
Total		$11,120,723.73

Preliminary estimates have been made for several branches of municipal work at Grand Rapids, Mich. The city charter is pending at Sing Sing, N. Y., consequently no public work is in project at present. Erie and Titusville, Pa., have more paving in contemplation. Plans are being made for a complete sewerage system at Ithaca, N. Y., but it will not be perfected until late in the summer or fall.

A NEW FORMULA FOR CROWNS IN PAVEMENTS.

A radical departure has been made by Mr. Andrew Rosewater from the practice heretofore in vogue in the adoption of a formula for crowns in pavements based upon the gradients of the streets paved. In explanation, Mr. Rosewater says:

"A street upon a steep grade requires much less crowning than a comparatively level street, and in the case of asphaltum this is particularly so. Observing that on Douglas street, between Fifteenth and Sixteenth streets, which has a very high crown, the asphaltum first laid in 1882 had not required resurfacing, and comparing that to some streets with high crowns laid under direction of H. F. Meryweather, city engineer of Denver, as to effects of easy traffic, I decided upon a crown equal to 1½ per cent. of space between curbs, or 3 per cent. of the space from crown to gutter, as safe and conducive to greater longevity of the pavement. This is explained upon the theory that water and mud being the great destroyers of asphalt pavement, when stagnant, any method that will practically preclude conditions which develop it, without affecting the safety and ease of traffic, is the most desirable. When a street has a gradient equal to or greater than 3 per cent., that in itself will carry off the water and mud, so that with such gradients the crowns can be reduced to a minimum. This practice largely overcomes the tendency to cupping on asphalt streets, a tendency largely due, in my opinion, to careless or incompetent overseers. It is generally conceded that no pavement looks better and is more pleasing to the public than a perfect asphalt pavement. On the other hand, an asphalt paved surface impervious in its nature to water, shows the slightest undulations or inequalities because it holds all moisture and forms mud until evaporation has done its work. Thus a depression of a quarter of an inch over a few feet will assume the appearance of a large pond hole,

and as is largely the case when mixed with the droppings of horses and urinal liquids becomes offensive as well as unsanitary. The crowns upon streets paved with asphaltum vary under this new rule from forty-five one-hundredths of a foot to nine-tenths of a foot, the one being on a street with a space of thirty feet between curbs and the other on streets having sixty feet space between curbs."

AN INSTANCE OF WASTEFUL CHEAP WORK.

A great deal of dissatisfaction is experienced with the manner in which the streets of Worcester, Mass., have been paved and repaired for a number of years, the result of which is that the city has scarcely a rod of first-class pavement. When the streets were paved, it was in the cheapest possible manner. From half an inch to two inches of sand was placed over the bed of the street, on which granite paving blocks were set up edgewise and pressed into place by means of wooden mauls. At the time the work was completed, it presented a good, even surface, but teams and heavy wheels soon rendered it uneven and full of sunken places. The macadamized streets were made in the same unsatisfactory manner, consisting of a few inches of broken stone spread upon the road-bed, covered with fine gravel and sand or pulverized stone, made very wet and then pressed into place with a heavy steam roller. One of the reasons given for such poor work is that enough money is not placed at the disposal of the highway department to enable it to build the new streets and avenues required by the rapid growth of the city, and to keep up, at the same time, repairs on the older streets. Another reason is that the work is not done on modern plans. The money that has been expended has been more to the purpose of making a show of length of paved streets than to produce good, economical and lasting pavements. It is estimated that one million dollars would be required to put the streets in condition to keep them in first-class repair.

REQUIREMENTS AS TO WHEEL TIRES.

John P. Prichard, street commissioner of Medford, Mass., in a letter to the *Boston Herald*, says:

"The street department of the city of Medford adopted wide tires three years ago, and all the wagons and carts for carrying heavy loads are equipped with tires ranging from four to five inches. On the four-wheeled carts we use five-inch tires on the rear wheels and four-inch tires on the forward wheels; the front axle is shortened eight inches so that we roll a space of eighteen inches when the cart is in motion. On the two-wheeled carts we put four-inch tires; on the offal wagons, four-inch tires; on the street watering wagons, four-inch tires, with the shortened front axle. These vehicles will go over frogs, switches and grooved railroad tracks without any hindrance whatever. I do not claim that wide tires will make good roads, but they will keep good roads in good repair. The question really is: Which is the better economy, wide tires and good roads or narrow tires and bad roads."

SENATOR MANDERSON'S VIEWS ON MUNICIPAL GOVERNMENT.

At the recent annual meeting of the Washington Congregational Club, Senator Manderson, of Nebraska, delivered an address, in which he advocated a change in the

present system of municipal government. He said that "it is unfair that, in so many cases, men control the funds of a municipality who have no interest in its welfare and prosperity. Private corporations have no right to furnish light, water or transportation for municipal purposes. If there is profit in conducting these enterprises, the municipality should conduct them and reap the benefits, and it is the duty of good citizens to see that this is brought about."

ASPHALT IN PHILADELPHIA.

The asphalt controversy in Philadelphia goes on apace, with the Trinidad asphalt in the lead at present. Director of Works Windrim says he has no objections to amending his specifications for asphalt paving so as to read "Trinidad asphalt, or asphalt as good, or superior," but he declines to make any experiments with Burmudez or other asphalt as yet untested by five years' use in Philadelphia, unless councils command it and assume the responsibility. He also wants the Washington practice followed, of paying a sufficient price to make contractors repair all defects in paving as soon as discovered; and also of employing experts to test every cargo of asphalt used, even when these cargos come from exactly the same spot. Meanwhile, as the specifications demand that all repairs to asphalt-paved streets shall be made with the same material originally used, the Pennsylvania Company, which paved the forty-two miles of asphalt streets in Philadelphia, has a monopoly of all repairs, as no other company can buy Trinidad "lake" asphalt for use in that connection. The competing companies, however, are continuing the fight for recognition.

THE MUNICIPAL FRANCHISE PROBLEM.

The increasing number of people who believe that there should be a change in the attitude of municipalities with reference to grants of franchises to corporations for the rendering of public service will be greatly interested in a volume just issued by Robert Clarke & Co., of Cincinnati, entitled, "The Law of Incorporated Companies, Operating under Municipal Franchises." The author is Mr. Allan Ripley Foote. It is not merely a legal work, as the title may lead one to suppose. The author discusses the economic law of labor and property, the resources of industry, the organization of industry and of municipalities, the needs and advantages of cities, and the various relations of law and economics in municipal government, with reference to illuminating gas, fuel gas, electric, telephone, street railway, water and other such companies the work is of inestimable value to municipal officers who, if earnestly interested in the duties which are intrusted to them, will not willingly be without it.

The fundamental ideas of the author with reference to the economic principles involved in legislation pertaining to incorporated companies operating under municipal franchises, are set forth as follows: First.—That the political groups into which society is subdivided for purposes of government can not exercise a greater intelligence than is expressed by the political action of the average voter. Second.—That the standards of economic morality by which the governing bodies of the various groups guide their action, can not be higher or truer than the standards by which business affairs are governed. Third.—That since men have not attained to that de-

gree of development which justifies the assumption that they can be depended upon, on all occasions and under all circumstances, to do the right simply because it is right, they can not be depended upon to be animated by true patriotism in dealing with public affairs.

His arguments are based upon these propositions. He would require from public service corporations a most exact accounting in consideration of the concessions granted to them, and would require submission to supervision conducted wholly in the interest of public welfare.

As a step toward the improvement of present conditions, Mr. Foote proposes that there shall be created, as a part of the state judiciary, a department of municipal administration for the collection and publication of statistics of industrial companies, this department to be also a court of equity for consideration of complaints from both owners and patrons of corporations operating under municipal franchises.

He thinks that corporate bonds or stocks should represent actual investment and that the companies should be allowed to charge rates sufficient to cover all necessary expenses and afford a reasonable dividend on the investment, the rate to be fixed by the state from time to time. Any surplus then remaining, he thinks, should be divided equally between the municipality and the corporation—except that a portion of that going to the latter should be divided between their employes. His method, Mr. Foote thinks, would fully protect the public against excessive charges, would secure for it satisfactory service and would be fair to the corporations. He argues that sound economics necessarily partake of good morals, and on this ground only can be based a satisfactory solution of the municipal franchise problem. [The Law of Incorporated Companies Operating Under Municipal Franchises. By Allan Ripley Foote. Charles E. Everett, A. M., LL. B., Editing Attorney. Robert Clarke & Co., Cincinnati, publishers. Three volumes.]

RECENT REPORTS OF MUNICIPAL OFFICERS.

In the twenty-second annual report of the board of street commissioners, of the city of Hartford, Conn., further progress is urged in the laying of improved pavements in the principal business streets, and as a substitution for macadam, which, the board says, the city has outgrown. The city has less than one-tenth of a mile of vitrified brick pavement, which was laid in 1892, and, practically, is in as good condition as when first constructed. A law was enacted in 1893 by the General Assembly, empowering the court of common council of the city of Hartford to cause the streets of the city to be paved and repaved with paving material other than macadam, whenever the owners or proprietors of two-thirds of the land abutting upon any street or portion of a street shall petition for such paving. The board says: "We believe the expenditure each year of $25,000 in improved pavements would be economy. This amount, expended each year for ten years, would accomplish a vast deal in the way of permanent improvements in our streets. Macadam does very well for residence streets, but the city has outgrown it for business streets."

The bi-yearly report of Mr. C. Baillarge, city engineer of Quebec, Canada, shows that during the past two years the city has laid about

5,000 square yards of block stone paving; 41,655 lineal feet of macadam; 666 yards of stone and cement sidewalks and crossings; 70,800 lineal feet of wooden sidewalks and crossings; 1,550 feet of stone curbing to side-walks. The city has used 13,361 cubic yards of broken stone in repairing macadamized and other roadways. The report says that while much has been done, much more remains to be done. The paving of hills and low-lying commercial streets is urgently advised, where nothing but a solid paving of stone setts will ever stand the traffic and the destructive action of water rushing down the declivities, tearing and moving away everything before it.

W. B. Howe, city engineer of Concord, N. H., in his first report from that department since its organization in March to December 31, 1893, gives the total length of sewers constructed during the season, as follows: Concord proper, 9,322 feet; West Concord precinct, 4,606 feet; Penacook precinct, 970 feet. Mr. Howe advises, as a probable saving of a great deal of expense, that sewers be built by contract instead of by day work; that the amount required for the services of an inspector in contract work would be amply repaid by the quality of work performed.

The statement of Henry Kelling, city clerk at Walla Walla, Wash., for the three quarters of the present fiscal year, July 1, 1893, to April 1, 1894, shows that the total issue of warrants for the three quarters just ended is $15,520.97 less than for the same period in the fiscal year, 1892–93.

DISSATISFIED WITH THE ROAD MASTERS.

For some time past a great deal of dissatisfaction has been felt by the citizens of North Hempstead, N.Y., with the manner in which the road masters in many of the districts have cared for the roads. This dissatisfaction has led to a movement on the part of the people to adopt the contract system of keeping the roads in repair. With the present system a tax-payer has the option of working a day on the road or pay $1 for each day he is assessed. The result is that little work or improvement is accomplished. If the resolution, to be submitted to the voters, is carried, thirty-eight road masters will be legislated out of office. The citizens claim that "road masters, as a rule, are not partial to having the taxes worked out; they prefer to receive the money and hire their own help, which, oftentimes, is no help at all."

USE OF COAL TAR PITCH IN STREET PAVING.

At the tenth annual meeting of the Ohio Gas Light Association, which was held in Columbus, March 21 and 22, Mr. R. Watt, of Chicago, read a paper entitled: "Coal Tar Pitch; its Uses and Future Market." Referring to it as an essential in street paving, Mr. Watt said:

"In street paving the advantages of pitch have frequently been demonstrated. In many cities specifications call for from ten to twenty per cent. of refined Trinidad asphalt, added to the pitch or cement employed in paving; but this clause is rarely complied with. Practical men know that the addition of this asphalt is more of a detriment than a benefit to the pavement, and they condemn and reject it, even when set forth in the specifications. City authorities, as well as contractors, know that block stone pavements are not satisfactory or durable, unless pitch has been used for filling

the crevices or cementing the blocks together. Years of costly experiments were needed in many instances to substantiate this fact; but to-day pitch filling is regarded as of the utmost importance, since pavements so treated are more lasting and less subject to ravages of water than those which have been laid without pitch as cement and filler. Indeed, pitch pavements are practically impervious to water, and accordingly escape its corrosive or undermining effects.

"In eastern, central or southern cities, where brick pavements have largely superseded all other styles, it has been proven that without a pitch filling such pavements are like leaky roofs in wet weather. The rain percolates through the crevices and injures the foundation, rendering repairs necessary in a very short time. Pitch, on the other hand, prevents the brick from absorbing moisture, effectually seals up the joints and keeps the pavement firm and intact. Should the pavement sink from any cause, the points of fracture join naturally together again; whereas, with hydraulic cement or mineral grout of any kind, breaks and cracks are hard to repair, and pavements so laid soon present a ragged and uneven surface.

"Coal tar pitch was extensively used for the vulcanite asphalt pavements in Washington, D. C., which are admitted to be the finest in the country. A recent estimate shows that 1,500,000 yards of asphalt and 500,000 yards of vulcanite have been laid in that city with pitch or coal tar distillate; and in all instances where the proper ingredients or proportions have been used, the results have been in the highest degree satisfactory. Pitch is also used to excellent purpose in floorings of establishments where there is much moisture. Where oils or acids are liable to fall, an asphalt floor laid with pitch is superior to asphaltum alone. Petroleum softens asphalt, but it has no effect whatever on a floor of coal tar pitch. These facts have been recognized in numerous cities. In Pittsburgh, Pa., fully eighty per cent. of the asphalt pavements have been laid with pitch with splendid results."

NEW ELECTRIC RAILWAY CONDUIT SYSTEM.

A closed conduit electric railway system has been invented by Mr. Frank M. Ashley, of New York. A hermetically sealed conduit is located midway between the two rails of the track. On the opposite side the conductors are laid in sections of eight feet each and are insulated from each other from the ends of the sections. These sections within the conduit are connected by branch conductors with corresponding sections on the surface of the street. Within the sealed conduit is a small four-wheel traveling truck, which is made of iron. Two wheels on one side of the truck rest on the main conduit or on one side of the conduit, and the two wheels opposite rest on the branch conduit or on the opposite side. The car is made long enough to cover three lengths of the sectional conductors at one time. Suspended above the conduit of the car proper is an electro-magnet which controls the traveling truck within the conduit, the traveling truck acting as the armature to the magnet. As the car moves along, this small car in the conduit moves with it and successively switches the current from the main conductor to the sectional conductors. The operation of the system is logi-

cally as follows: The current leaves the dynamo, follows the main conductor until it comes to the small truck within the conduit, passes through the truck to the sectional conductor in the conduit, thence through the branch conductor to the corresponding section on the street, thence to the rheostat in the car, thence through the motor, and returning completes the circuit through the continuous rail on the opposite side of the road-bed. This system will be put in operation in a short time."

Another conduit system which has attracted a great deal of attention among electricians and street railway men, has been invented by Mr. H. Petersen, of Milwaukee, Wis. The main object of this invention is to guard against an accumulation of dirt and moisture within the conduit. It is known as a double compartment conduit system. It is constructed with two longitudinal compartments; one is arranged to contain the electrical conductors and the other to carry off any water that may find its way to the inside of the conduit; this latter compartment is connected, at intervals, with the sewers, and a steel broom attached to the cars sweeps the accumulation of dirt in this compartment and deposits it in the sewer. The second compartment is placed out of the line of the slot, and in the opening in the upper part of the wall between these two compartments is a device, consisting of vertical strips of metal jointed and adapted to be raised between guides, which is kept closed when the car is not passing, but is so arranged as to be automatically opened by the trolley arm. This permits no moisture getting into the compartment containing the conductors and the slot rail extends far enough down to prevent any water getting on the closing device.

It is thought that condensation will not take place in this compartment, for it is, to all practical purposes, entirely shut off from the interior compartment, making its temperature the same as that of the wall of the conduit. Instead of using wires for conductors, it is considered more reliable to use iron or steel contact rails, which are divided into sections of about one hundred feet. A section is tapped on the two main feeders and provided with switch and safety cut-outs placed in manholes so that in case of some trouble occurring, one section can be switched off without delaying traffic on the whole line. The whole compartment is coated with waterproof insulating paint, and the main feeders are laid in pipes. The depth of the conduit is less than that required for a cable conduit. The trolley arm is provided with two contact shoes, which almost surround the upper part of the contact rail, preventing them from jumping the conductor. The shoes have a swivel arrangement, and by means of springs keep in proper contact with the conductors. From each contact shoe wire is laid through the hollow arm and extended up to the motor, and at each end the arm is hermetically sealed. By moving a lever the motorman can, from his platform, lift the contact carrier out of the conduit at the manhole without delaying the car for more than a minute. This device for putting the contact wire under the surface of the street will soon be tested on a section of road. Comments and opinions expressed by those who have examined it are very favorable.

A STRAW BRIDGE.

In the northern part of Hardeman county, and seventeen miles from Quanah, Texas, flows Red river, a stream which, in times of high water, is very treacherous. For miles, when approaching the river, one sees nothing but very fine sand, and the banks, bottom and waters of the river are red. The road approaching Red river on each side, has, for several miles, a roadbed with a depth of this fine sand, which makes it almost impossible to pull a heavy load through. A fine bridge was erected, but a few weeks later, when the rains came, the rising, surging waters of Red river washed it away in just a few hours, and since then, there has been constructed a "straw bridge," which is three miles long, four or five feet high and wide enough for wagons to pass on any part of it. This bridge is composed of sand, straw and grass, and is made by placing a layer of straw and grass on the sand, then a layer of sand on the straw and so on in this manner until the desired height and width is reached, when it is ready for the public. When the rains come, the bridge can not be used, but when the river recedes again, the rebuilding of the bridge is begun by the owner of it. From fifty to one hundred wagons pass over it daily and each one contributes a small toll to the owner of the bridge, for its aid to loaded wagons is invaluable.

CHICAGO'S GREAT CANAL.

The huge drainage canal being constructed by Chicago will be forty-two miles long, one hundred and sixty feet wide, and twenty feet deep, and will admit the passage of the largest lake vessels. The flow of the water will be one mile an hour, and 600,000 cubic feet per minute will be discharged into Lake Joliet, a pool in the Desplaines river, where the canal reaches a terminus. Contracts to the amount of $14,000,000 have been let up to the present time, and, with this immense sum of money, it will be a comparatively inexpensive improvement, when one considers the enormous amount of labor required to construct it, and the vast benefit to be derived from it after construction.

It will be so large that it will not only drain the Chicago river, but enough of the lake to carry all of the sewage of the city to the Illinois river, and thence to the Ohio and Mississippi rivers. A valuable water power will be developed near Joliet, which will be worth vast sums of money, there being, within a distance of twelve miles, a fall of seventy-five feet. The head of navigation on the Illinois river is La Salle, and a project, not at all improbable, is that the State of Illinois will, before the present work is completed, extend the canal to that point, which would create a waterway for large vessels, extending from the great lakes to the Gulf of Mexico. The importance of this probable development of a perpetual water-power, has awakened a feeling of serious interest and uneasiness among the business men in various cities in the east, where it is feared that the enormous dimensions of the canal will cause Lake Michigan to cease sending its waters to the ocean by way of Niagara, thereby causing, not only great loss of water, but fears are entertained lest much of the freight that now passes through the eastern cities on its way from the northwest to the sea-coast will find an outlet here.

THE SUPPLY OF TRINIDAD ASPHALT.

In a recent address before the American Institute of Mining Engineers, Col. F. V. Greene discussed the "Production of Asphalts," presenting many interesting facts pertaining to the subject. He said:

"The asphalt of Trinidad is found in what is called a lake, having an area of 114 acres, located about three miles from the sea, at an elevation of about 100 feet above it. From borings that have been made the body of asphalt is found to vary from eighteen feet near the shore to seventy-eight feet near its center and to contain about 6,000,000 tons of asphalt. The source of the asphalt is not known, but from the fact that about 180,000 tons have been taken out without appreciably lowering its level it is believed the lake is supplied from underground sources.

"The word 'lake' as applied to this body of asphalt is wholly a misnomer. Instead of being liquid it is a level tract resembling earth, its surface seamed with fissures filled with water and earth, which support a scrubby vegetation. The deposit is at the bottom like the surface, and carts with mules are driven over it anywhere. The asphalt is dug with pick and shovel, loaded into carts and hauled to the beach, where it is placed in baskets and carried by coolies through the surf to lighters, from which it is loaded into vessels. Upon the vessels the pieces unite again in a solid mass and it has to be removed with pick and shovel once more.

"In preparing it for the market the crude material is placed in tanks and heated moderately by fire for five days, during which time the vegetable impurities rise to the top, while the earthy matter settles to the bottom. Great care is required not to heat the asphalt to a point where chemical change takes place. After being purified in this manner it is drawn off into barrels for shipment."

LEGAL DECISIONS.

(Reported Specially for Paving and Municipal Engineering.)

Designation of Street Paving Material. — The Supreme Court of Michigan decides that where a city charter permits streets to be paved, either on petition of a majority of the abutting owners or by a five-sixths vote of the common council, that, in the latter case, the council designation of material is binding on the board of public works. Common Council of City of Grand Rapids *v.* Board of Public Works of City of Grand Rapids, 58 N. W. Rep. 335.

Statute of Limitations as to Right to Open Street.—Under the statutes providing that every public highway laid out and dedicated to the use of the public, that shall not have been opened and worked within six years at the time of its being laid out, shall cease to be a road for any purpose whatever, where a street in which the city has acquired only an easement, and not the fee, is laid out an entirety, but worked and opened only in part, the public loses its right therein after the lapse of six years. City of Buffalo *v.* Hoffeld (Superior Court of Buffalo, Equity Term), 27 N. Y. Supp. 868.

Who are Fellow Servants. — An engineer of a city steam roller, who has a flagman under his orders and dischargeable by him, in carelessly starting the roller without warning is the flagman's fellow-servant, not his vice-principal. Hanna *v.* Granger Sup. Ct. of R. I., 28 At. Rep. 659.

Right of Property Owners to

Street.—Where one buys lots according to a plat showing a street immediately adjoining, he acquires only an easement therein, and can not take possession of any part thereof, and exclude therefrom the vendor, who has lots on the other side of the street, though the authorities have not accepted the street. Merrill *v.* Newton, Supr. Ct. of Mich., 58 N. W. Rep. 70.

Adverse Possession Against City.—When a person who has been in the actual, visible, exclusive and uninterrupted possession of a portion of a street in a city, under a claim of right, for ten years the title thereto vests, absolutely in such occupant. Lewis *v.* Baker, Supr. Ct. of Neb., 58 N. W. Rep. 126.

PERSONALS.

Mr. C. B. Channel has been reappointed city engineer, at Kearney, Neb.

Mr. Edward S. Orr has been elected mayor of the city of Tacoma, Wash.

Mr. John G. Peene has been elected mayor of the city of Yonkers, New York.

Mr. Robert S. Rathbun has been nominated for city engineer, at Allentown, Pa.

P. H. Golden has been elected street commissioner, at Dallas, Texas, for a term of two years.

Mr. J. B. Putnam has been appointed superintendent of waterworks and sewers, at Worcester, Mass.

Mr. R. H. Gamble has been elected city civil engineer, at Lima, Ohio. Mr. Gamble succeeds Mr. James Pillars.

Mr. S. Whinery, manager of the Warren-Scharf Asphalt Company, read a paper before the Engineers' Club, at Minneapolis, April 16.

Mr. William Steyh, was re-appointed city engineer, April 2, by the city council of Burlington, Ia., making his twelfth year of service in this capacity.

Mr. George H. Allen, of Manchester, N. H., has been appointed designer and consulting engineer for the extension of the sewerage system, at Littleton, N. H.

Messrs. W. E. Coosette and Alexander Harper, of Chicago, recently visited New York City for the purpose of examining New York's method of assessing and collecting water rents.

Mr. H. H. Edgerton has been appointed chairman of the sewer commission, at Rochester, N. Y., to succeed Mayor George W. Aldridge, who resigned recently, to accept the mayoralty.

The following officers were elected for the ensuing year at the late city election, at Waseca, Minn.: Mayor, D. T. Cummings; president of council, W. H. Smith; aldermen, M. J. Hanson, W. L. Herbst, Henry Murphy, Robert Reichel and P. C. Bailey; recorder, Thos. F. McLoughlin.

LETTERS FOR THE PUBLIC.

A RULE TO REDUCE CIRCULAR SEWERS.

To the Editor of Paving and Municipal Engineering:

I contribute herewith a rule to reduce circular sewers to oviform, of the usual proportions:

$$\text{Diam. ft.} \times 5 = \frac{\text{minor axis}}{2} \text{ in inches.}$$

H. Ward.

Binghamton, N. Y., April 14, 1894.

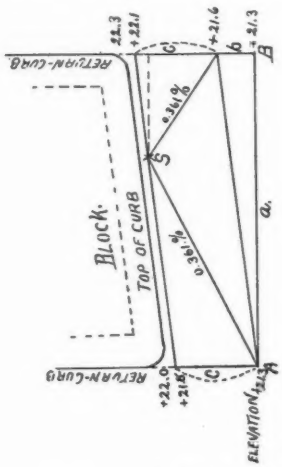
HOW TO DETERMINE THE SUMMIT OF GRADE BETWEEN RETURN CURB LINES IN CROSS STREETS.

To the Editor of Paving and Municipal Engineering:

In regard to municipal engineering I send you the following problem, hoping some engineer "up to snuff" will solve it, as I had to last summer, by algebra.

To determine the summit of grade between return curb lines in cross streets from which summit the per cent. or descent of gutter grade shall be *equal*, and greater than any that can be found in the block.

This summit *s* was found by determining the distance *x* (see diagram) from the following data:



Given A B=300′=a
21.6—21.3=0.3=b
22.1—21.6=0.5=c
etc., as per elevations.

To find the distance x=108,453 ft., and the per cent.=0.361% as marked.

F. R. Lockling,
City Engineer and Sewer Commissioner.
Hannibal, Mo.

SELECTIONS FROM THE PRESS.

PAVING BRICK; TESTS OF QUALITIES.

The use of brick for street paving is by no means a new or untried experiment. Brick pavements have been in use in Holland for over one hundred years; in parts of England, for over forty years; at Charlestown, W. Va., for twenty-one years, and in other cities from five to twenty years, and with very satisfactory results.

The prominence which brick paving is taking is very apparent to any one who has given the matter attention, nor is this surprising when we take into consideration the difficulties which have been experienced with other forms of pavement and the many advantages which brick offer for this purpose. The remarkable degree of success where test pavements have been laid has justly done much to enhance their popularity, and it is the opinion of those who have given the matter most earnest thought and investigation that good, hard-burned, vitrified brick will be the paving material of the future.

Kind of Brick Suitable for Pavers.—In constructing a brick pavement the kind of brick used is a matter of the utmost importance, as one pavement laid with imperfect, porous and soft brick will do more harm to the brick paving interests than a dozen well laid, durable pavements will counterbalance. The brick should be of such density as to be practically impervious to water, and consequently not subject to the action of frost. A brick that will absorb water to any considerable extent is unfit for paving from the fact that the water which it will absorb in wet weather will, in winter, freeze, causing rapid disintegration. A good paving brick should also possess toughness and tenacity to such a degree that the edges will not break off nor the surface of the brick wear rapidly when exposed to heavy traffic. A tough, vitrified brick is by far the best form of paving material, combining imperviousness to water with great strength and durability. A common hard brick is liable to be burned hardest at the surface, and when this is worn through will be subject to much more rapid and irregular wear, but a properly vitrified brick will possess the same degree of hardness throughout, and the wear will be uniform and practically imperceptible.

There are a variety of tests for determining the density, strength and durability of paving brick, the principal ones of which may be briefly described by us as follows:

The Absorption Test.—This test is for the purpose of determining the imperviousness of the brick to water, and is conducted by immersing the bricks in water for a period of from six to twenty-four hours or longer. The bricks are weighed before and after the immersion. The surface moisture should be wiped off before the final weighing of the brick.

The Tumbling Test.—This test is to determine the toughness and wearing quality of the brick. The brick are placed in a revolving cylinder such as is ordinarily used by founders for cleaning castings. The tumbling cylinder may revolve from ten to twenty or even as high as fifty revolutions per minute. With the brick, in the cylinder, there are added pieces of iron or other hard, rough substances. The length of the test varies from one to ten hours. It is estimated by some that each half hour's test of this kind is equal to twenty years' wear upon the brick with ordinary traffic.

The Grinding Test.—In this test the brick are ground by large circular disks revolving rapidly, a heavy weight being placed upon the brick.

Crushing Test.—The brick are ground off or faced up so as to be perfectly true, are laid upon edge between flat surfaces, and pressure applied until they are crushed.

The Drop Test.—The toughness and strength of the brick is sometimes determined by dropping a heavy weight a number of times upon the brick and noting the result.

Breaking Test.—Another test for showing the capabilities of the brick for resisting breaking strains is determined by placing the brick on edge between sharp surfaces and noting the pressure at which a fracture takes place.

In the judgment of experienced engineers who have given the matter careful attention, brick, in order to be available for paving purposes, should be capable of withstanding a pressure of at least ten thousand pounds to the square inch, and should absorb not over three per cent. of water, nor show a wear of

over ten per cent. in a half hour's test by the tumbling process, and if they show better results than this, their adaptability as paving material is, of course, proportionately increased.

Size and Form of Paving Brick.—This is a matter upon which different opinions are prevalent. The majority of paving brick manufacturers, however, agree that rounding or beveled corners are preferable to the sharp corners, being less liable to be broken off and affording a foot-hold for horses. The use of brick the size of ordinary building brick offers some advantages from the fact that should the pavement need repairs at any time it would be easier to secure brick of the proper size, and, further, from the fact that any brick not burned hard enough for paving can be readily disposed of for building purposes. This is an important consideration to most brickmakers, as in this way they can dispose of their entire product.—*Clay, Willoughby, O.*

THE CHEMISTRY OF PAVING BRICK MANUFACTURE.

The alkalies of potash in the clays is a residuum of decayed organic matter. It is an active fluxing agent, and in the process of burning, or so-called vitrification, causes amalgamation of the iron and silica components, which imparts a metallic tone or ring to the brick when struck. When aided by finely pulverized lime or magnesia in the presence of a large percentage of iron, a pale double silicate of lime and iron is formed, imparting a buff tint to clays that would otherwise burn red. In the fire-clays less than one-half per cent. of potash or alkali produces no noticeable result, and the product has good heat-resisting qualities, but when from one to three per cent. of this ingredient is found in the clay, and it contains from four to eight per cent. of iron, which it generally does, with perceptible quantities of lime and magnesia at a high temperature (usually a white heat), these fluxing components form vitreous combinations with the silica, producing a brick uniform throughout, and it is allowed to cool gradually, without coming in contact with cold air until below the temperature of boiling water, or, in other words, is properly annealed, you have the so-called vitrified brick, which absorbs about two per cent. or less of moisture, and has great strength to resist crushing or abrasion. This product may be used quite fearlessly for street paving.

With the plastic clays or shales the melting or vitrification occurred at a lower temperature, and owing to the fact that the ingredients are seldom uniformly mingled, there is greater danger of melting the brick together in the kiln, or of leaving many of them without vitrification. To render them apparently impervious to moisture, many manufacturers have adopted the plan of glazing them with salt, which may be beneficial in some respects, but is objectionable in others. These clays usually contract to a greater extent in the process of drying and burning than the fire-clays do, and hence are more liable to be warped from their proper form, or show injurious fire-cracks. But no clay can be made into good street paving brick, unless the process of firing or burning be continuously progressive and comparatively slow to the maximum temperature, and the cooling down be gradual and continuous. This can not be done in the ordinary clamp kiln. A broken brick showing varieties of texture or color is a certain indica-

tion of defective combination or burning, and the fault is fully as liable to be in the burning as elsewhere. Uniformity in the product of the kiln is a necessary condition to the successful manufacture of clay of any kind into proper form to be used for street paving; and only with such clays, and such appliances as will enable the manufacturer to attain this result, can he reasonably hope to achieve success. —*The Brickmaker.*

A SENSIBLE STREET-CLEANING SYSTEM.

Intelligent people can not witness the occasional and spasmodic efforts to clean the streets of Philadelphia, resulting in numerous piles of dirt, some of which get carted away while others are left to be spread by travel and the wind, without wishing that a system of streets and street surfaces designed to be kept constantly clean could be provided as is done in the great cities of Europe. Such a system would cost little more than our own patchwork of cobblestone, block and smooth asphalt, and if once adopted would greatly simplify as well as cheapen the process of street-cleaning. Streets made to be kept clean and placed under the supervision of a department that would try to make some creditable approach to performing the work it pretended to perform would not be a very expensive luxury after all.

An article on "Street Cleaning in Foreign Cities" in the current number of PAVING AND MUNICIPAL ENGINEERING [March] describes the method of street-cleaning in Paris, which is at once so simple and withal so sensible that one wonders it has not been universally adopted where conditions favor, and that every city does not as fast as possible provide the conditions necessary to make it practicable. * * *

This plan, which produces absolutely clean streets, requires three preliminary conditions, good sewers, well paved streets and a sufficient water supply. When these exist clean streets can be maintained at a very small cost by this method either in Paris or Philadelphia. The advantage which modern Paris has over Philadelphia in this respect is that its systems of sewers, street surfaces and water supply are parts of a harmonious whole designed in part to maintain clean streets at a moderate cost. In Philadelphia no part of our municipal system of improvements fits any other part. The water supply is fast becoming inadequate for ordinary purposes; the sewer system is a confused misfit; the street surfaces are a patchwork of all sorts of pavement, and the street cleaning contractors are allowed to follow their own sweet will as to methods.

Antagonistic as these conditions are to a cheap and effective system of street cleaning, such as is enjoyed by Paris, it is not impossible to gradually improve them. A new and more copious water supply must be secured in the near future. We are gradually substituting asphalt and block for cobblestone and rubble pavement, and in the newer portions of the city the sewer system begins to have some approximation to the demands upon it. Gradually it should be possible to introduce the European system of every-day sweeping and washing of the streets, thus dispensing at once with the daily accumulations of dirt and the carts which now make a pretense of hauling it away. Philadelphia should not be above adopting a sensible plan of street cleaning if it has failed to originate one.—*Philadelphia Times.*

PATENTS RELATING TO PAVING.

Brick Machine, 516,883. William Zortman, Allegheny, and George R. Ward, Pittsburgh, assignors of one-third to Charles H. Balp, Pittsburgh, Pa., consists of the combination of a pug-mill, a brick press, having a vertical reciprocating plunger, a horizontal reciprocating bottomless mold into which the clay may be forced by the plunger, and a vertically reciprocating pusher to push the bricks from the mold.

Attachment for Brick-Making Machines, 517,010. Lemuel Patterson, Allegheny, assignor of one-half to George H. Albertson, Pittsburgh, Pa., consists of an endless belt and means for operating the same, a frame carrying said belt capable of being adjusted vertically, and knives attached in an oblique position on the said belt, all arranged and combined for service.

Clay Feeder, 516,995. Milton F. Williams, St. Louis, Mo. Has its hopper-bottom formed by a coil of heating pipe inclosed at the sides by timbers, and underneath by a board, whereby the heat is kept from wasting, and the escape of dirt through the bottom is prevented, said feeder being suitably provided with means for conveying the clay along the said bottom.

Garbage Crematory or Furnace, 516,706. William L. Johnson, Chicago, Ill. Consists of a combustion chamber into which the garbage is delivered, and a blast directed against said garbage to keep it in motion along said combustion chamber.

Machine for Crushing and Grinding Asphalt Rock, 517,311. John H. Tabler, Russelville, Ky. Consists of a fire-box having a cylindrical extension forming a heating chamber, a feed cylinder held to revolve in such a chamber, and crushing rolls at the discharge end of said cylinder, adapted to receive the dry-hot rock as it passes from the cylinder.

GarbageCrematory,517,288. John E. McKay and Alfred D. Delanoy, New York, N. Y. Consists of a furnace having grate bars and a retort or combustion chamber at the end thereof and provided with an inlet for refuse at its upper end, combined with the grate in the lower part of the chamber and a revolvable frame having inlet and outlet connections for water and consisting of radial tubular arms, and connecting horizontal tubes.

Method of and Apparatus for Repairing Asphalt Paving, 517,191. Amos H. Perkins, Chicago, Ill., consists in subjecting the part to be repaired to a blast of superheated air, adding new material and smoothing and burnishing it.

Mold for Brick Machines, 518,-185. Emil Fernholtz, St. Louis, Mo., assignor of one-half to Jacob Stock and Henry C. Beckman, same place, consists of sides and ends formed of separate pieces, fitting and bearing squarely against each other; the end pieces having a fixed contact and full bearing with the side pieces; and formed with the channel and bolts passing through the ends of the side and through the end pieces, whereby the ends may be set up as they become worn.

Kiln for Baking or Burning Bricks, 518,153. Fred McCarthy, Sayreville, N. J., assignor of one-half to the Sayre & Fisher Co., same place, consists of a series of chambers, a furnace arranged on one side of each chamber, a furnace arranged on the opposite side of each chamber, and flues passing beneath the bottoms of the chambers, partitions arranged in the said flues and extending to the bottoms of the chambers, a series of flues extending from opposite

sides of the partition, around the bottom, sides and top of the chamber, and communicating with furnaces, and also communicating with the said flues on the opposite side of the said partitions, and also a flue arranged alternately with respect to the said flue and extending around the sides and top of the said chambers and communicating with the said furnaces, and also communicating at one of their ends with the aforesaid flues.

Kiln for Burning Brick, 517,893. Samuel K. Smith, New Brighton, Pa., consists of a central quadrangular flue of like section with the equatorial connecting flue and having two of its sides paraliel therewith and the other two sides opening therein; a series of radial flues, opening at their inner ends into said quadrangular flues and at their outer ends into damper controlled "uptakes" flues in the wall of the kiln, a second series of radial flues, interposed between said open end flues, and closed at their inner ends, but with their outer ends passing through the kiln wall, fitted as fire-holes and provided with tight doors; "ports" or openings connecting said radial flues each with the other; a series of parallel flues built upon and connecting the said radial flues and quadrangular flues, and a "ported" perforated floor superposed upon said parallel flues, whereby, when "fired" in the "fire-hole" of the radial flue, the products of combustion are distributed evenly over the entire floor space and arise within the kiln.

V. H. Lockwood,
Patent Solicitor.

Indianapolis.

THE PAVING BRICK INDUSTRY.

The Mack Manufacturing Company, of Pittsburgh, which now controls seven paving brick plants with an annual capacity of 100,000,000 brick, has printed a pamphlet of eighteen pages, giving some valuable information regarding the paving brick industry. Referring to their own experience, they say:

"A pavement is an engineering structure, and the manufacture of high grade paving brick requires as much study and as much thought as a larger engineering work. We are the pioneers in the manufacture of brick for street paving, and for many years have given our entire time and energy to this business; have studied the character of all paving materials, experimenting step by step; analyzing our raw and finished products, and every department of our establishment, from the laboratory through which our clay is chemically treated, to the kilns in which we vitrify, is in charge of an expert. In short, we have reduced the business to a science. Our plants, totally unlike the brick-yards of old, are modern concerns, fitted out with the latest improved machinery, called into existence by the needs of our business for grinding, mixing and tempering the clay, and for molding and repressing the brick. Our clay is peculiarly adapted to our purpose, analyzing as follows:

Silica	62.90
Alumina	23.05
Peroxide of Iron	6.17
Lime	.25
Magnesia	.95
Potash	.10
Water	6.58

"The brick are burned at a very high heat, consequently the iron, lime, magnesia and potash are chemically combined with the silica and alumina, forming a thoroughly vitrified brick, yet possessing the requisite toughness. The weather will have no effect on it in any way.

"The kilns in which our brick are burned are models of engineering science, in which any desired degree of heat can be obtained, and so regulated that the heat can be controlled so that we secure thorough vitrifaction and uniformity in our product. Its strength, demonstrated by tests, is second only to granite.

"We began with a small plant; our brick were first used on the hardest traffic street of Wheeling, W. Va., and the excellence of our first piece of work led to the repaving of all the leading streets with our material, and from this our brick have won their way into over one hundred cities and towns in all parts of the country, ranging from one mile to fifty miles of street."

On the general subject of street paving, the following is set forth, with reference especially to vitrified brick:

"As compared with granite and sheet asphalt the cost of construction is much less, as shown by the following figures, compiled from the records of the city of Chicago by Mr. D. W. Mead, engineer, and from records of the city of Philadelphia.

"The frequent disturbance of a pavement is often the leading factor in its destruction, so that the facility with which pavements can be taken up and replaced becomes quite important. Brick being of absolutely uniform size and shape can be returned to their place without any loss, and at a much less expense than either granite or asphalt.

"Combining, as it does, toughness with vitrifaction, enables brick to withstand without wear, the abrasion due to the striking of calks and toes of horses' shoes and the impact of passing loads. The irregularities of the surface in granite blocks causes great wear by a loaded wheel rising and falling in its passage over it. Vitrified brick, forming a regular surface, does not have this to contend with, and in ability to stand heavy traffic is second only to granite. Vitrified brick is made of the most lasting material, its elements have reached their most stable form, so can not be affected by atmospheric changes." [Mack Manufacturing Co., Pittsburgh, Pa.]

COST OF MAINTENANCE, AS SHOWN BY FIGURES COMPILED BY MR. MEAD.

	Classes of Traffic.					
	Heavy.		Medium.		Light.	
	Chicago.	Philadelphia.	Chicago.	Philadelphia.	Chicago.	Philadelphia.
Sheet Asphalt,	Not used.	$2.75 per sq. yd.	75c. per sq. yd.	$2.75 per sq. yd.	50c. per sq. yd.	$2.75 per sq. yd.
Granite,	54c. per sq. yd.	3.25 per sq. yd.	37c. per sq. yd.	3.25 per sq. yd.	28c. per sq. yd.	3.25 per sq. yd.
Vitrified Brick,	36c. per sq. yd.	2.10 per sq. yd.	23c. per sq. yd.	2.10 per sq. yd.	16c. per sq. yd.	2.10 per sq. yd.

CROSS SECTION OF STREET PAVEMENT

TESTS OF PAVING BRICK.

H. S. Bosler, city engineer of Terre Haute, Ind., makes the following report on tests of paving brick made under his direction on March 30:

ABRASION TEST.

Time in rattler.....1 hour.
Maximum fall.....15 inches.
No. of revolutions.....500.
No. of brick used.....15.

Name of Brick.	Per Cent. of Loss.
Hallwood Block	.0200
Clinton Repressed	.0352
Canton Block	.0363
Royal Paver	.0386
Wabash Clay	.0394
Royal Standard	.0428

ABSORPTION TEST.

Time in water.....48 hours.
Put in water after being taken out of rattler.

Name of Brick.	Per Cent. of Gain.
Clinton Repressed	.0036
Canton Paver	.0042
Hallwood Block	.0058
Canton Block	.0060
Canton Standard	.0068
Royal Paver	.0069
Wabash Clay	.0080
Canton Fire Clay	.0165

THE DECATUR LEADER BRICK MACHINE.

The Decatur Leader Manufacturing Company have made some improvements in their brick machine. They consist chiefly of an increase in the weight, and consequent strength of the machine, and a wrought-iron platform covering for the gearing. Falling particles of dust and other bodies are successfully kept from contact with the gearing and bearings, and at the same time free access can be had to them for lubricating and inspecting purposes, as well as for taking up the wear. This machine is complete in every detail and ample in strength, has a roller feeder in hopper, hinged die-front with safety break-pin, double end-thrust bearings, heavy forged steel shafts, powerful gearing, large bearings, and perfect lubrication. The tempering knives are in pairs, clamped over a square shaft, and are made of hard iron. The auger is cast in a chill and carefully ground. With this machine is supplied, without extra charge, a friction clutch pulley and suitable die, either dry or lubricating. When used in connection with their automatic cutter, supplied with suitable material and power, under ordinary conditions 40,000 to 50,000 bricks per day can be produced. For side cut brick a suitable table is provided instead of the automatic cutter. For paving, foundation and sewer brick, or where great density is required, a dry die is preferred, as it offers more resistance to the flow of clay through it, and causes more clay to be compressed into the brick. For building and general purpose brick a lubricating die is preferable; as the bricks are not quite so dense, they dry and burn sooner and with less fuel, besides a large saving in power is effected. [The Decatur Leader Manufacturing Co., Decatur, Ill.]

IMPROVEMENTS IN MOORE'S HOISTER AND CONVEYOR.

The heavy demand of sewer contractors for the "Moore Hoister and Conveyor" has caused the company to increase their capacity for manufacturing this machine. The latest patterns and designs require fewer parts than heretofore. The machine will be constructed entirely of steel, with the exception of the power house, which encloses the engine. The "Up to Date," 1894, machines will, in addition to economically handling earth excavation, endure the heaviest rock blasting, which can be carried on without any covering whatever. Their steel machines need no protection from flying rocks and are constructed especially to dem-

onstrate that they are the only machines which will work directly over the blast. Their No. 4 machine has worked on the East Side trunk sewer in Rochester, N. Y., completing two miles of work in rock excavation, and has had approximately, fifty thousand cubic yards of rock blasted under and through the steel trestle without costing a cent for repairs. The new machines will be stronger than ever and simplified greatly. They were used last year by contractors in Buffalo, Rochester and Hornellsville, N. Y., and Indianapolis, Ind. This year the company has orders up to date for machines in Buffalo, Rochester, Syracuse, Indianapolis, Chicago, Aurora, Ill., South Bend, Ind., and New Orleans, La.

NOTES.

Samples of brick made from the new clay recently discovered on the farm of George Hopke, near Quincy, Ill., have been examined by competent brick men and pronounced as hard as any they had ever seen. A thorough test will soon be made, and if it proves successful Mr. Hopke will soon begin manufacturing paving brick.

The California Petroleum and Asphalt Company of San Francisco, Cal., will establish a large plant in Kansas City, Mo., and enter into the competition for asphaltic paving in that city. The plant will involve an expenditure of $200,000.

The Western Paving and Supply Company has been incorporated at Milwaukee, Wis., with a capital stock of $60,000. The incorporators are James T. Bannen, Fred Krause and Henry Weber.

Clay is the name of a new quarterly magazine devoted to the clay-working industries, published by J. W. Penfield & Son, of Willoughby, Ohio. The initial number comprises thirty-six pages. It is beautifully printed and attractively illustrated. It begins auspiciously, and promises to be fully equal to its opportunities in a field of large and growing possibilities. The subscription price is 50 cents per annum.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Poughkeepsie, N. Y., is experimenting with slag for paving purposes.

Jefferson street in Savannah, Ga., which is being paved with Belgian blocks, is about completed.

The paving of Hazel street, Danville, Ill., is completed and opened to traffic. Work has also been resumed on Vermillion street.

The estimated cost of asphaltic paving in Milwaukee, Wis., in portions of Jefferson street, and Grand avenue, is $94,000, of which $51,000 will be assessed against property owners.

W. G. Elliott, mayor of the city of Williamsport, Pa., has given notice that the requirements of the ordinance, relating to digging up the streets for water, gas and sewer connections, will be, in the future, rigidly enforced.

The road commissioners of Whitman, Mass., have accepted plans for the rebuilding of the main street between Whitman and Brockton. The road is one of the most important under the care of the county commissioners.

The entire width of Fayette street, from Calvert to Liberty street, Baltimore, Md., is being regraded and repaved with Belgian blocks. This improvement was necessitated by the street having been made the regulated width. The work involves many other changes in that thoroughfare.

CONTEMPLATED WORK.

Street paving is being agitated in Marseilles, Ill.

Street paving is being agitated at Reynoldsville, Pa.

One-half mile of brick paving is being agitated for Titusville, Pa.

Indian Hill avenue, Madisonville, O., will be macadamized at a cost of $46,000.

A plan has been proposed, at Rome, N. Y., for the improvement of the streets.

An effort is being made at Harvey, Ill., to pave 154th street with vitrified brick.

An asphaltic pavement will probably be constructed on Main street, at Racine, Wis.

An effort is being made at Tiffin, O., to pave Jefferson and Madison streets this summer.

Main, Fourth, Third and Second streets Washington, Ind., will be paved with vitrified brick.

Middletown, N. Y., contemplates the construction of 9,000 square yards of asphalt block paving.

A Macadam road has been petitioned for, to extend from the end of the Raytown road to Lone Jack, Mo.

The city council of Dayton, O., has declared it necessary to pave Keowee, Fifth, King and Valley streets.

Eldert street, Brooklyn, N. Y., will be paved with cobblestones, from Central street to Hamburg avenue.

It has been proposed to the city council at Keokuk, Ia., to macadamize the upper end of Main street to the city limits.

It is proposed to lay a concrete or macadamized top to the cobblestone pavements in Alexandria, Washington, D. C.

The board of public works at Jacksonville, Fla., has declared it necessary to pave Bridge and Bay streets with vitrified brick.

An asphaltic pavement is contemplated for Perry street, Peoria, Ill. It will be one of the handsomest drives in that city, when paved.

An asphaltic pavement will be laid on John street, from Fourth to York, Cincinnati, O. An ordinance has been passed to that effect.

Richmond, Ill., has voted to expend $1,000 in improving the highways. The citizens are interested in the subject of hard roads.

The council of Cleveland, O., has passed an ordinance providing for repaving James street with dressed Medina sandstone on a concrete foundation.

Ordinances were adopted at Streator, Ill., April 2d, for paving north Bloomington, west Wilson, South Park, north Sterling and East Hickory streets.

An ordinance passed in New York City, provides for an asphaltic pavement on Seventy-first street, between West End avenue and the Hudson river.

An ordinance was passed, at the April meeting of the common council at Schenectady, N. Y., to pave, with sheet asphalt, south Center street, from Union to State streets.

The Baltimore County Commission has been petitioned to pave Clinton street, Canton, at a cost of $12,000, the property-owners on Clinton street bearing one-third of the cost.

The city council at Muscatine, Ia., recently approved brick paving for Mulberry and Second streets and Iowa avenue, about two miles in all. The work will be done this summer.

A bill was passed by the councils at Williamsport, Pa., April 12, providing for the paving of Pine and Third streets. Vitrified brick is specified in the bill, but asphalt was suggested.

Preliminary estimates for street paving for 1894, in the city of Dayton, O., are as follows: Brick and block, $613,919; Medina stone, $920,474; asphaltic paving, $696,-194; asphalt blocks, $824,540.

The city council at Oakland, Cal., recently passed resolutions providing for the following: Paving Bay Place, with class "B" macadam; paving Ninth street with bituminous sand-rock; paving Goss street with class "C" macadam.

C. M. Rickard, city engineer at Springfield, Ill., writes that about three miles of brick pavements will be contracted for in the near future, and that there is some talk of constructing a handsome boulevard to extend from the city limits to the state fair grounds, a distance of about a mile and a half.

At a special meeting of the Merchantville (N. J.) borough council recently a motion was adopted to submit to a vote of the people a proposition to macadamize the streets in that borough. Estimates made place the cost of Telford roads on all of the streets at $73,000, and a six-inch macadam road on all of the streets at $50,000.

The estimated cost of the proposed ten-foot asphaltic walk on the west side of Fifth avenue, from Eighty-fifth to One Hundred and Tenth streets, New York City, is $61,850, if done by day labor. To pave Fifth avenue from Ninetieth to One Hundred and Tenth streets, with granite on concrete foundation, by day labor, will cost $165,000.

Ordinances were passed in the councils at Baltimore, Md., April 2d, favorable to the following: Repaving Warren avenue with asphalt blocks, from Light street to brow of Federal Hill; Washington street, from Monument to Fayette streets; Fayette street, to eastern city limits; Macadamizing Monument street, from Luzerne street to Loney's Lane; paving and curbing unpaved portions of Riggs avenue, between Fremont avenue and Calhoun street; repaving Orleans street with Belgian blocks; repave, with asphalt blocks, Patterson avenue, Maryland avenue, Charles street and Saratoga street.

CONTRACTS TO BE LET.

Pekin, Ill., will pave 12,000 square yards, with brick. U. J. Albertsen.

F. A. Elrod, city clerk at Muncie, Ind., invites bids until May 7 for improving sundry alleys.

Plans have been prepared for paving sundry streets with brick, at Belleville, Ill. Fred Daab.

O. R. Rauchfuss, city engineer at Joliet, Ill., writes that bids will probably be asked in May, for paving Cass street.

Plans and specifications have been ordered prepared for paving a number of streets with vitrified brick, at New Orleans, La.

Bids will be received at Keokuk, Ia., until May 7 for paving sundry streets with limestone, macadam and gravel. W. H. Jones, city engineer.

Bids will be received until May 15, at Cincinnati, O., for the improvement of Elberon avenue. Fred Bader, president board Hamilton County Commissioners.

Bids are invited at Franklin, Ind., until May 15, for paving North Main street with broken stone and curbing with stone or cement curbing. W. D. Greene, city clerk.

Sealed proposals will be received by J. M. Harper, corner Ninth and Plum streets, Cincinnati, O., until May 12 for macadamizing Franklin street, in Norwood, O. W. E. Wichgar, city clerk.

Sealed proposals will be received at Marshalltown, Ia., until May 14, for paving with vitrified brick Main street and South Second avenue. Specifications can be seen at the office of J. G. Trotter, city clerk.

Sealed proposals will be received until May 8, at St. Louis, Mo., for constructing an improved Telford pavement, granitoid cross-walks, alley entrances and sidewalks on Union boulevard. Robert E. McMath.

Bids will be received at Madisonville, O., until May 12 for macadamizing and graveling Clason street. Information and blanks can be secured from D. S. Hosbrook, corner Fifth and Main streets, Cincinnati, O. Bennett Carter, village clerk.

Sealed proposals will be received by the board of public improvements, at St. Louis, Mo., until May 8, for constructing a Telford pavement, granitoid curbing and guttering on Union boulevard, between Forest Park and Delmar boulevard. Plans and specifications can be seen at the street commissioner's office.

CONTRACTS AWARDED.

The contract for paving State street, Alton, Ill., was awarded to Ryan and Burke, of that city.

The Warren-Scharf Asphalt Paving Co. was awarded the contract for $80,000 worth of street paving at Muncie, Ind.

Whitmore, Rauber and Vicinus, who have the contract for paving Maine street, Rochester, N. Y., will begin the work about May 1.

The contract for graveling and curbing the business streets of Silverton, Ore., was awarded to the Salem Improvement Co. for $1,409.

John De Less & Co., of Jacksonville, Ill., secured the contract for several thousand feet of stone curbing for the city of Keokuk, Ia.

The Barber Asphalt Paving Company was the lowest bidder for the asphaltic paving on west Washington street at Fort Wayne, Ind.

O. R. Rauchfuss, city engineer at Joliet, Ill., writes that the contract for paving Center street was awarded to Campbell and Dennis, of Joliet.

The contract for paving, grading and curbing Oregon, Polk and Mt. Vernon streets, Oshkosh, Wis., was awarded to John Martin for $28,000.

The contract for paving Pryor street, Atlanta, Ga., was awarded the Standard Paving Company for $2.19 per square yard. Vitrified brick will be used.

Mr. O. N. Gardner, who secured the contract for street paving in Jamestown, N. Y., will begin laying the brick about June 1. Mr. Gardner's bid was $88,000. The contract calls for the completion of the work by November 1.

Director E. M. Bigelow, Pittsburg, Pa., awarded the contract for asphaltic paving in the East End, to Booth and Flinn at a total cost of $379,737.25. About $1,000,000 will be spent in Pittsburg this year on street improvements.

The Quartzite Macadam Company secured the contract for furnishing sufficient rock to macadamize State street, a distance of 450 square yards, ten inches deep. The company's bid for the rock, delivered, was $1.42 per square yard.

The contract for paving Jay street, in Schenectady, N. Y., was awarded to John Twomey, at a meeting held April 10 by the common council. The paving will be of asphalt block and will cost $2.75 per square yard, including curbing and excavation.

The San Francisco Concrete and Construction Company was awarded the contract for paving and curbing Railroad avenue, in San Francisco, from its junction with Kentucky street, to Eighteenth avenue, a distance of sixteen blocks. The estimated cost of the work is $80,000.

The contract for paving Somerset street, Johnstown, Pa., was awarded to W. A. Parker. The paving which was to have ended at Haynes street will be extended to South street.

Udo Hesse, city engineer at Saginaw, Mich., writes that contracts for paving were awarded, April 21, as follows: Paving Franklin street, from Tuscola to Potter streets, with sapless cedar blocks on concrete, D. J. Kennedy, of Bay City, Mich., $10,049.40; Genesee avenue, from Hartsuff street to Holland avenue, with sapless cedar blocks on concrete, D. J. Kennedy, of Bay City, Mich., $8,933.69; Michigan avenue, from Bristol street to Genesee avenue, with sapless cedar blocks on sand and board foundation, Scanlan and Crowley, of Saginaw, $24,122.25; Niagara street, from Mackinaw to Court streets, with Telford macadam, Peter Malcolm, of Saginaw, $5,566.55; Niagara street, from Ames to Madison streets, with Telford macadam, Peter Malcolm, of Saginaw, $2,477.92.

SEWERAGE.

The construction of sewers at Macon, Ga., was begun April 3, by Gaboury and Noble, to whom the contract was awarded.

The New Orleans Sewerage Company has begun work on the sewerage system. A Moore hoister and conveyor has been erected and the work will be pushed rapidly forward.

The sewer bill of 1893 at Westchester, N. Y., has been repealed. It was in every way opposed to home rule and took from the citizens the right to vote upon the expenditure of their money.

The sewer on Center avenue, at Harvey, Ill., is completed and has been accepted by the village board. The work, which was done by Ulrick, Nessley and Williams, of Springfield, O., is pronounced highly satisfactory.

CONTEMPLATED WORK.

A system of sewers is proposed for Monticello, Ill.

A sewerage system is contemplated at Collingswood, N. J.

A plan is on foot at Sacramento, Cal., to improve that city's sewers.

Liberty, N. Y., contemplates the construction of a sewer system.

The council, at Racine, Wis., has been petitioned for better sewerage.

Profiles for the West Bluff sewer, at Peoria, Ill., have been completed.

Maple avenue, Norwood, O., will be improved by the construction of a sewer.

Norwood, O., has been empowered by the Legislature to spend $20,000 for sewers.

The citizens of Woodsville, N. H., contemplate extending their sewerage system.

Sewers will be constructed in several streets during the summer, at Schenectady, N. Y.

The estimated cost of the proposed sewerage system for Attleboro, Mass., is $67,700.

Mayor Cleaver, Council Bluffs, Iowa, advises the improvement of the Indian Creek sewer.

There is a movement on foot at Oshkosh, Wis., to construct a large main brick sewer in Main street.

The road committee at Montreal, Que., has decided to construct a brick sewer on Mignonne street.

The board of health at St. Louis, Mo., has voted to construct a sanitary sewer in Clarendon avenue.

Wahpeton, N. D., is contemplating the construction of a half mile of sewers in the main business streets.

A resolution presented to the council, at Quincy, Ill., recently, advises that the sewer system of that city be revised.

The council at Youngstown, O., has resolved to construct a sewer in Highland avenue, from Arlington street to Spring street.

The city engineer of Mankato, Minn., has made estimates of the cost of the proposed sewers in North Fifth and Sixth streets.

The proposed sewerage system at Huntsville, Ala., will probably not be constructed before fall. Address the mayor for information.

The council at Atlanta, Ga., has adopted an ordinance to construct a sewer along and in Third street, at an estimated cost of $4,610.

A sewer district has been established in the Sixth ward of the borough of Dunmore, Pa., and sewers will be constructed on Adams, Jefferson and Monroe avenues.

The residents of the South End, Circleville, O., have petitioned for a sewer. It is known as the Sears sewer and has been petitioned for a number of times before.

H. Ward, Binghamton, N. Y., writes that surveys have been ordered for the construction of sewers on the following streets: Whitney, Tudor, Sandford, Lyons, Stuyvesant and Fayette streets.

The city council of West Knoxville, Tenn., has decided that a sewerage system, independent of connections with the old corporation, can be constructed cheaper than the plan of 1893 provides for, which was to connect with Knoxville proper.

Surveys and plans are being made for a sewerage system at Sistersville, W. Va., by Miller and Chessell, of Martin's Ferry, O.

A system of sewerage is being agitated at Jermyn, Pa. A private company composed of residents of the city has asked for the right to sewer the borough, but a great many of the residents are opposed to its being done by a private company.

D. T. Mathers, city clerk at Woodbury, N. J., writes that the city is contemplating a system of sewerage and that the matter has been referred to the street committee of council to obtain plans and estimates. B. W. Andrews, chairman of committee.

Alonzo J. Hammond, Frankfort, Ind., writes that resolutions have been passed for the construction of about 350 feet of thirty-inch storm sewer. Specifications have also been adopted for a main sanitary sewer and about 9,500 feet of 18 to 24-inch pipe sewer.

C. M. Rickard, city engineer at Springfield, Ill., writes that an ordinance has been passed and plans and specifications prepared for the construction of about 1,600 lineal feet of brick sewer seven feet in inside diameter. This sewer will be constructed with a single ring of paving brick laid in Portland cement mortar. The construction of a sewer of this size with a single ring of brick will be something new in sewerage construction where the combined system is used, and in the event that it gives perfect satisfaction it will be of great importance to many cities throughout the country.

CONTRACTS TO BE LET.

Los Angeles, Cal., has contracted for fifteen miles of sewers.

A system of sewerage will be constructed at Everett, Mass., by John Sheehan, of Lynn, Mass.

Bids are invited until May 1 at Menasha, Wis., for constructing a sewer. John Landgraf, city clerk.

Messrs. Langely & Jeynes were the lowest bidders on the Beaubien street sewer, at Detroit, Mich.

H. J. Farley, Cleveland, O., invites bids until May 2, for the construction of sewers in sundry streets.

The contract for sewering Ridge street, Alton, Ill., was awarded to Ryan and Burke, of that city.

The contract for sewers at Warren, O., was awarded to T. E. Gibbons of Youngstown, O., for $1,273.43.

Sealed proposals will be received at Le Mars, Ia., until May 15, for constructing four miles of pipe sewer, including manholes and flush-tanks. E. P. Sammio, city clerk.

The contract for the Tiffany street trunk sewer, New York City, was awarded to Jones and Brosnan, for $161,000.

The contract for the Walnut street sewer, at Peoria, Ill., was awarded to Hallett and Anderson, of Aurora, for $25,651.69.

Messrs. Meyer & Peride, of Lancaster, Ohio, were the lowest bidders for the construction of sewers at Nelsonville, Ohio.

Messrs. Gooch and Pray, of Boston, Mass., secured the contract for the new pumping station at East Boston, for $23,-450.

Mr. John Hales, of Roseland, Ill., was awarded the contract for putting in sewer tile on Halsted street, Harvey, Ill., for $1,-131.60.

Bids are invited, at Sandusky, O., until May 5, for the construction of a sewer in North Depot and Camp streets. A. W. Miller, city clerk.

Sealed proposals will be received at Bradford, Pa., until May 7, for all sewer pipe to be used for the ensuing year. James A. Lindsay, city clerk.

Sealed proposals will be received until May 7, at Albany, N. Y., for constructing a vitrified stoneware pipe sewer in Canal street. T. J. Lanahan.

Messrs. Kirkland and Starkey, of St. Paul, Minn., secured the contract for constructing the sewers on Fifth and Byrom streets, Mankato, Minn.

Sealed proposals will be received until May 8, at Amsterdam, N. Y., for constructing a storm sewer through McDonnell and Union streets. Howard Putman.

Sealed proposals are invited at Cortland, N. Y., until May 5 for constructing about 5,560 feet of pipe sewer, 24 inches internal diameter. Fred Hatch, city clerk.

Alonzo J. Hammond, city engineer at Frankfort, Ind., writes that the contract for 1,250 feet of lateral sewers, 8 to 12 inches in diameter, will be awarded May 7, 1894.

Plans have been made at Belleville, Ill., for one mile of 42 to 36 inch brick sewer, estimated cost $30,000, and twenty miles of 24 to 8 inch pipe sewer, estimated cost $100,000. Fred Daab.

The contract for the Goodman street sewer and the new State Hospital sewer, at Rochester, N. Y., was awarded to John Mauder, for $28,206.60. The estimated cost of the work was $37,000.

Sealed proposals will be received until 3 o'clock P. M., May 1, 1894, at the office of the city clerk, Rockford, Ill., for the construction of sewers on the Fifth street sewer district. F. G. Hogland, city clerk. See advertisement of sealed proposals.

Sealed proposals will be received at St. Louis, Mo., until May 8, for the construction of sundry sewers. Robert E. McMath.

The contract for the construction of a main sewer in and along Liberty, Market and Noble streets, Indianapolis, Ind., was awarded to the Acme Paving and Construction Company; Michigan street, H. C. Roney; Lockerbie street, Acme Paving and Construction Company.

Contracts for the construction of main sewers were awarded in Philadelphia, Pa., as follows: Aramingo canal system to James Sullivan; Fifty-sixth street to Charles J. Kennedy, Jr.; Fifty-first street extension to C. P. Grier & Co.; Green street, Germantown, to James Sullivan; Indiana street to George S. Good & Co.; Cuzeine street extension to George F. Mills; Montgomery avenue to B. F. Dutton; Ontario street, Delaware river to Aramingo canal, James Sullivan; Orthodox extension to B. F. Dutton; Ross and Upsal streets to John Kerrigan; Thirty-third street to C. P. Grier & Co.

Bids were received at Brockton, Mass., recently, for a sewerage system. Each competitor submitted bids on city labor and contract labor as follows: National Construction Co., city labor, $27,535.33, contract labor, $23,309.14; Lucien A. Taylor, city labor, $28,825.68, contract labor, $24,153.78; Joseph Long, city labor, $31,-172.12, contract labor, $26,185.40; Metropolitan Construction Co., city labor, $31,-803.65, contract labor, $27,646.62; Andrew W. Bryne, city labor, $49,674.55, contract labor, $30,658.21; Dennis O'Connelly, city labor, $40,077.60, contract labor, $31,492.97; Charles McDermott, city labor, $47,747.30, contract labor, $37,753.20. In each instance, an increase of from fifteen per cent. to sixty-two per cent. for city labor is noticeable over that of contract labor.

WATER-WORKS.

The city council of Henrietta, Texas, has accepted the water-works.

The new inlet pipe to the water-works plant at Cedar Rapids, Iowa, has been completed.

CONTEMPLATED WORK.

Lander, Wyo., is contemplating water-works.

Griffin, Ga., contemplates a system of water-works.

A system of water-works is being discussed for Cuba, Ill.

A system of water-works is being agitated at Gilmore, Iowa.

An extension of water-mains is contemplated at Bremen, Ind.

Henry, Ill., contemplates establishing a system of water-works.

A system of water-works has been proposed for Centerville, Ill.

Grant, Oregon, is agitating the question of a system of water-works.

The question of water-works is still being considered at Wenona, Ill.

The citizens of Mauston, Wis., are agitating the subject of water-works.

Thorpe, Wis., has voted to expend $6,000 this year for a system of water-works.

The village of Buchanan, Mich., contemplates the construction of water-works.

The mayor of Northfield, Minn., Mr. Joel Heatwole, is in favor of bonding the city for water-works.

The mayor of Globeville, Colo., has indorsed the ordinance to bond the town for $25,000 for water.

Springfield, Minn., has decided to put in, at once, the water-works plant which was voted for last year.

Water-mains will be laid in several streets in Schenectady, N. Y., during the summer, at a cost of $22,000.

The city council of Helena, Mont., is considering the water question. The contract with the present company expires this summer.

The village council of Delano, Minn., have decided to advertise the bonds of that village and to receive competitive plans and propositions for water-works.

C. M. Rickard, city engineer at Springfield, Ill., writes that the superintendent of water-works will lay about four miles of six-inch cast iron water pipe during the summer season.

The water-works question is an important one at Augusta, Ga., with public-spirited citizens. The present system is becoming inadequate to the demands made upon it, as the growth of the city increases.

CONTRACTS TO BE LET.

Sealed proposals will be received at St. Louis, Mo., until May 15 for water-works extensions. Robert E. McMath.

Sealed proposals will be received at Poplar Creek, Mont., until May 1, for the construction of a water-works system.

Sealed proposals will be received until May 4, at Kenyon, Minn., for the erection of water-works. A. P. Brobeck, village recorder.

Sealed proposals will be received until May 2, at Chicago, Ill., for furnishing and laying water service pipes in sundry streets. H. J. Jones, commissioner of public works.

Sealed proposals will be received until May 17, at Cleveland, O., for cast iron water pipe. J. H. Farley, director of public works.

Bids will be received until May 15, at Aiken, S. C., for the construction of a water-works system. Henry Busch, chairman water-works committee.

Proposals are invited until June 21, at Pittsburg, Pa., for furnishing a quantity of water-pipe, special castings, valves, etc. E. M. Bigelow, director of public works.

CONTRACTS AWARDED.

The contract for laying 7,000 feet of water mains at Perry, Ia., was awarded to Myers & Willis.

M. B. Birdseye, of Fayetteville, N. Y., was awarded the contract for water-works at Frankfort, N. Y.

W. S. Reed & Co., of Chicago, Ill., was awarded the contract for constructing water-works, at Ottawa, Ill.

The contract for the water-works plant at Martinsville, Ind., was awarded to Carruthers & Cain, of Newport, Ky.

Messrs. Pomerene & Cooper, of Lincoln, Neb., secured the contract for a water-works system at Alliance, Neb., for $16,000.

Kay & Coon, of Bellwood, Pa., secured the contract for building the water-works, at Salisbury, Pa. The contract price was $11,257.

The contract for the construction of water-works at Somerset, Pa., was awarded to C. E. Coon & Co., of Upper Sandusky, Ohio, for $12,965.07.

The contract for the construction of water-works at Friend, Neb., was awarded to the Fremont Foundry and Machine Company, of Fremont, Neb., for $16,075.

Harvey Linton, city engineer at Altoona, Pa., writes that at a meeting of the city council, March 28, the contract for the construction of the Kittanning Point reservoir, was awarded to Messrs. Collins & Martin, for $156,503. The capacity of the reservoir will not be less than 300,000,000 gallons.

Bids were received at Nelsonville, Ohio, March 13 for a complete water-works plant as follows: Coons, Murphy & Coons, Upper Sandusky, Ohio, $40,717.80; Stevens & Bedwards, Logansport, Ind., $44,900; Kelly Plumbing and Heating Co., Columbus, Ohio, $39,186; Coons & Darrow, Findlay, Ohio, $38,784.99; Shaw, Kendall & Co., Toledo, Ohio, $37,186; Brahnan & Gest, Cincinnati, Ohio, $49,575; Boughen Engineering Co., $48,882; W. M. Chisholm, E. Liverpool, Ohio, $47,814.55; A. G. Miller, Lancaster, Ohio, $45,025.50; Collins & Kennedy, Barberton, Ohio, $38,873.73.

BRIDGES.

A bridge across Sand creek is being agitated at Clermont, Iowa.

Melrose, Wis., has voted $2,000 to rebuild the bridge at North Bend.

A new bridge will be built over Deep creek near Spokane, Wash.

A bridge will be built across the Mississippi river at Aitken, Minn.

A new bridge will be built across the Stony brook, at Waterloo, Wis.

A new bridge is to be built at Dimondale, Mich., across the Grand river.

There is a movement on foot at Colona, Ill., to build a wagon bridge across the Rock river.

A new stone bridge is being contemplated over the Manitowoc river on State street, Chilton, Wis.

A movement is being vigorously made at Dexter, Ore., for a wire suspension bridge across the Middle Fork.

A new bridge has been authorized over the Boone river at the east end of Second street, Webster City, Ia.

The contract for a bridge across the Nemadji, at Superior, Wis., was awarded to Haugner & Dahl, for $13,167.75.

O. R. Rauchfuss, city engineer at Joliet, Ill., writes that Wheatland township has voted bonds for a bridge across the Du Page river near Wheatland.

The contract for building a bridge across the Puyallup river at Tacoma, Wash., was awarded to R. Wakefield, of Portland, Ore., for $79,696. It will be a draw of 248 feet.

The county commissioners of Trumbull county, O., have awarded to the Wrought Iron Bridge Company, of Canton, the contract for a new iron bridge over Musquito creek.

Sealed plans, specifications and strain diagrams will be received until May 9, for a bridge across Pudding creek and adjacent sloughs, near Yoncalla, Douglas county, Ore. George W. Riddle, county judge, Roseburg, Ore.

Bids will be received at Chicago, Ill., until May 1, for the design, manufacture and erection of the superstructures of one metal single-track railway swing bridge at Milan, Ill. W. L. Marshall, captain corps of engineers, 2258 Wabash avenue.

The new Brooklyn-Brighton bridge, at Cleveland, O., will probably be opened to traffic May 1. It is 1,542 feet long, and its greatest height is 65 feet. The bridge begins at Pearl street. It has a roadway of thirty feet and two sidewalks, each six feet wide. The bridge is built entirely of steel.

The park and boulevard commissioners of Detroit, Mich., will build eight bridges of iron and stone in Belle Isle Park. The commissioners have invited a number of Detroit architects to prepare and submit competitive designs. The architects whose plans are adopted will receive the usual commission of 5 per cent.

PUBLIC PARKS.

A park will be created at Traverse City, Mich.

A park has been proposed at Webster City, Ia.

Spokane, Wash., will begin this spring, work on a municipal park system.

The citizens of Belleville, Ill., are endeavoring to acquire land for park purposes.

The city of La Grange, Texas, has purchased land which will be converted into a public park.

The councils of Philadelphia recently authorized the purchase of a square of ground which will be devoted to the purposes of a public park. It will be known as Wharton Square.

The Big Four is converting a vacant lot, which lies east of their new depot at Anderson, Ind., into a park. Although small, it is said to give promise of being one of the prettiest parks in the state.

Ex-Senator Palmer has added seven acres more to the Log Cabin park, an original gift of his to the city of Detroit, Mich. The park now contains 127 acres. The last addition is heavily wooded, many of the trees being 200 years old, and it will be one of the most beautiful spots in the park.

SEALED PROPOSALS.

SEWERS.

CITY CLERK'S OFFICE,
ROCKFORD, ILL., April 10, 1894.

Sealed proposals will be received until 3 o'clock P. M., on the first day of May, 1894, at the office of the city clerk of the city of Rockford, Ill., for the furnishing of material, labor and constructing sewers on the Fifth street sewer district, consisting approximately of the following quantities: 786 feet 20-inch pipe, 724 feet 18-inch pipe, 1,104 feet 15-inch pipe, 4,378 feet 12-inch pipe, 5,246 feet 9-inch pipe 24 feet 18-inch cast-iron pipe, 16 6-inch Y's from 20-inch pipe, 12 6-inch Y's from 18-inch pipe, 20 6-inch Y's from 15-inch pipe, 102 6-inch Y's from 12-inch pipe, 154 6-inch Y's from 9-inch pipe, 18 man-holes (1 ordinary man-hole, 17 combined man-holes and catch-basins), 31 intakes, 1 flush-tank, 24 lamp-holes.

For information, form of contract, plans and specifications, etc., apply to the city engineer.

Two bids are desired, to wit:

One on basis of cash being paid to the contractor as the work progresses and is accepted by the engineer in charge (less the usual reserve).

One on basis that the contractor will accept the bonds which are to be issued in anticipation of the nine deferred installments. The bonds so to be is-

sued amount to $15,300 and will bear interest at the rate of 6 per cent. per annum (interest payable annually), one-ninth being due each year until paid.

Proposals must be accompanied with a certified check on some responsible bank for $500 payable to the order of the city of Rockford.

The city reserves the right to reject any or all bids, without assigning any cause therefor.

F. G. HOGLAND, City Clerk.

FOR SALE CHEAP.

One 20-ton Aveling-Porter Steam Road Roller.
One 20-ton Ross Steam Road Roller.
One 12-ton Harrisburg Steam Road Roller.
One 15-ton Harrisburg Steam Road Roller.

SECOND-HAND MACHINERY OF ALL KINDS.

DAVIS, KELLY & CO., - LOUISVILLE, KY.

ROAD ROLLER WANTED.

WEIGHT, 5 TO 7½ TONS.

SECOND-HAND.

State make, description, condition and price.

JAS. W. PEARL, Benton Harbor, Mich.

FOR SALE.

Three Combination Plastic Press Brick Machines. These machines are of an excellent manufacture and highly adapted to plastic clays. Also one Dry Press Machine and three Power Presses. Apply to or address

ALFRED YATES, MANAGER,
SOMERSET & JOHNSONBURG MFG. CO.,
JOHNSONBURG, PA.

WANTED.

BRIDGE SALESMAN.

One for each State in the Union, competent to make sales of Bridges and superintend erection when necessary. Address, stating age, experience, salary expected, etc., **L. B. 1107, CHICAGO, ILL.**

W. J. HAYES & SONS, BANKERS

• Municipal Bonds •

BOUGHT AND SOLD.

CLEVELAND, O. NEW YORK, BOSTON, MASS.
10 WALL STREET.

HENRY LEFFMANN, M. D.

ANALYSES OF WATERS AND FOODS A SPECIALTY.

715 WALNUT STREET,

PHILADELPHIA.

Pittsburgh Testing Laboratory, Ltd.

GEO. H. CLAPP, Chairman. ALFRED E. HUNT, Vice-Chairman and Treas.

116 WATER STREET,

PITTSBURGH, PA.

SPECIALTIES—Chemical tests of all kinds; inspection of water pipe; testing of brick and paving materials; inspection of structural material.

PATENT FOR SALE.

No. 498,463.

The only practical Bridge Gate yet invented. Simple in construction and automatic action. Can be applied to any abutment, and does not in any way interfere with the traffic. It closes up the exposed portions of the abutment as rapidly as the bridge moves away. Pedestrians can get on and off the Bridge until it clears the abutment. For particulars address

E. C. D., care Municipal Engineering Co.

BRICK MACHINERY

IN STOCK OR UNDER PROCESS OF ERECTION, WHICH WE CAN DELIVER ON SHORT NOTICE.

Decatur Brick Machines, with Automatic Cutter and Sander, 50,000 capacity.

Decatur Brick Machines, with Board-delivery Cutter, 35,000 capacity.

Leader Brick Machines, with Dies and Cutters to suit, 25,000 capacity.

Ideal Brick Machines, with Dies and Cutters to suit, 12,000 capacity.

Also Tile Machines, Disintegrators, Crushers, Pug-Mills, Elevators, Cars and Supplies.

FULL OUTFITS A SPECIALTY.
WRITE FOR INFORMATION.

The Decatur Leader Mfg. Co.

DECATUR, ILLINOIS.

Established 1848. Incorporated 1883.
J. WHEATON STONE, Mgr. Brick Machinery Dep't.
FRED. B. FARNSWORTH, Pres. and Treas.
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AND BRICK MANUFACTURING EQUIPMENT.

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LIDGERWOOD MFG. CO.
HOISTING ENGINES AND BOILERS.

ATLAS ENGINE WORKS.
PORTABLE AND STATIONARY ENGINES AND BOILERS.

BALL ENGINE CO.
ELECTRIC LIGHT AND RAILWAY ENGINES.

J. H. HOUGHTON, Sole N. E. Agt. { 203 Congress St. BOSTON, MASS.

ROAD TOOLS

Each of these machines

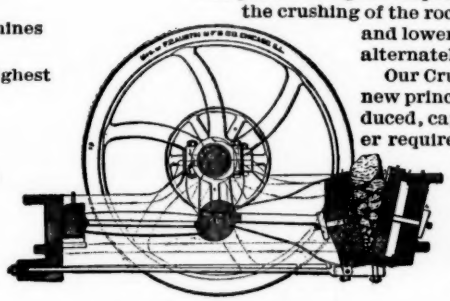
was awarded the highest

MEDAL

of merit in its class

at the

WORLD'S FAIR.



AUSTIN ROCK CRUSHER.

The jaws having a compound oscillating movement, the crushing of the rock is continuous, the upper and lower half of the jaws crushing alternately.

Our Crusher embodies an entirely new principle, whereby weight is reduced, capacity increased, less power required and life of Crusher prolonged. We claim (all things considered) to have the best Crusher made, and court comparison.

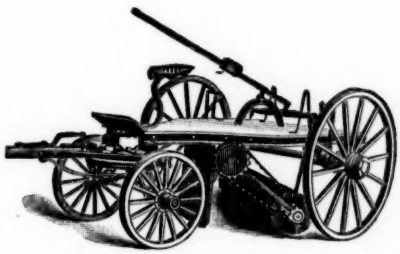
Capacity up to 250 tons per day.

No. 3—Capacity 10 to 15 tons per hour.

No. 4—Capacity 15 to 20 tons per hour.

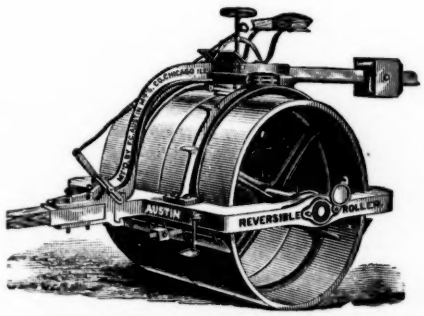
AUSTIN STEEL REVERSIBLE ROAD MACHINE.

The strongest, neatest and most complete Grader sold. Saves seventy-five per cent. in cost of work over old methods. Energetic agents wanted in unoccupied territory.



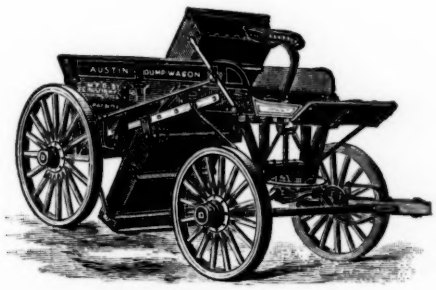
AUSTIN STEEL STREET SWEEPER.

Lightest running, strongest and most efficient. Two horses only. Sweeps 7½ ft. Cleans thoroughly any kind of pavement.



AUSTIN REVERSIBLE ROLLER.

Has anti-friction roller bearings. No weight on horses' necks. Is reversed or brake applied by driver without leaving his seat. Lightest draft and most easily handled—1½, 3½, 4, 5, 6 and 7 tons.



AUSTIN DUMP WAGON.

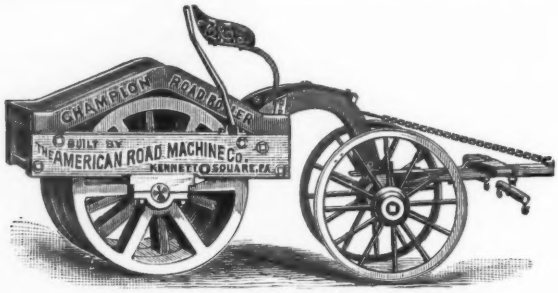
Quickly and easily dumped without stopping the horses. Has steel pan and steel-lined box. Holds 1½ to 2 yards. Used for hauling earth, brick, sand, stone, coal, street sweepings, etc.

FOR CATALOGUE AND PARTICULARS, ADDRESS

F. C. AUSTIN MFG. CO., Chicago, Ill.

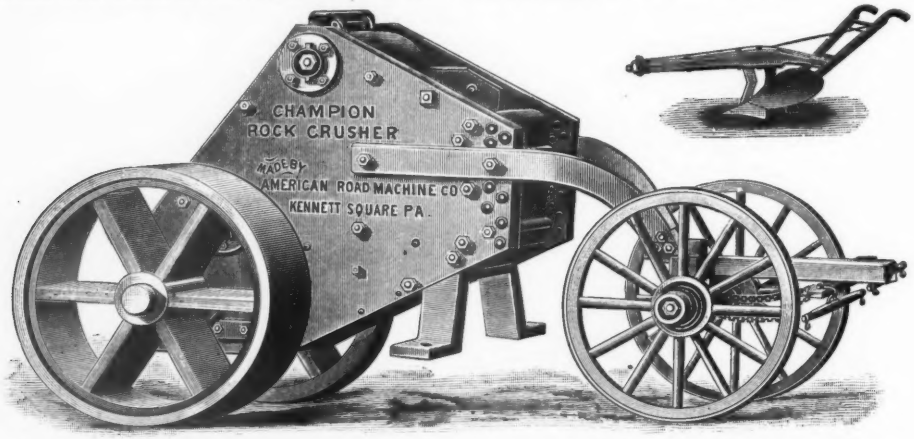
WHY

IS CHAMPION MACHINERY the most popular machinery of its class, and the standard by which all other road-working machinery is gauged?



THE CHAMPION ROAD ROLLER.

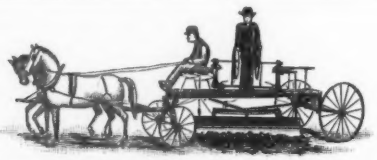
It is made heavy or light at will to meet requirements. It is made in sections and turns easily. It has front trucks to relieve team of neck-wear. We also make the Reversible Roller.



OUR CHAMPION STONE CRUSHER.

(Portable View.)

No.	Receivers.	Capacity Per Hour.	Approximate Weight.
3	7 x 13 inches.	7 to 10 tons.	5,000 pounds.
4	9 x 15 inches.	8 to 15 tons.	8,000 pounds.



STEEL CHAMPION. ***(Reversible.)***

The Steel Champion will demonstrate a saving of from one to three dollars an hour over any of the dump scoop methods of Road Building. It has less **Gearing**, less **Complication**, and **More Practical Adjustments** than any machine made.

Because

The longest experience, covering a period of sixteen years, the best talent that can be obtained, ample capital and the largest and best equipped plant for producing, are advantages which can not easily be approached, much less overcome.

Our machines are reasonable in price and fully guaranteed by a company of known responsibility.

OUR LEADERS.

Champion Reversible Road Graders (2 styles). Champion Steel Rock Crushers (2 sizes). Champion Reversible Road Rollers (4 sizes). Wheel Scrapers (2 styles, 3 sizes of each). Drag Scrapers (2 styles, 3 sizes of each). Road Plows (2 sizes, right or left-hand).

Our Catalogue tells the whole story. It is yours for the asking. Address

American Road Machine Co., or J. D. Adams & Co.,

Kennett Square, Pa. **Indianapolis, Ind.**